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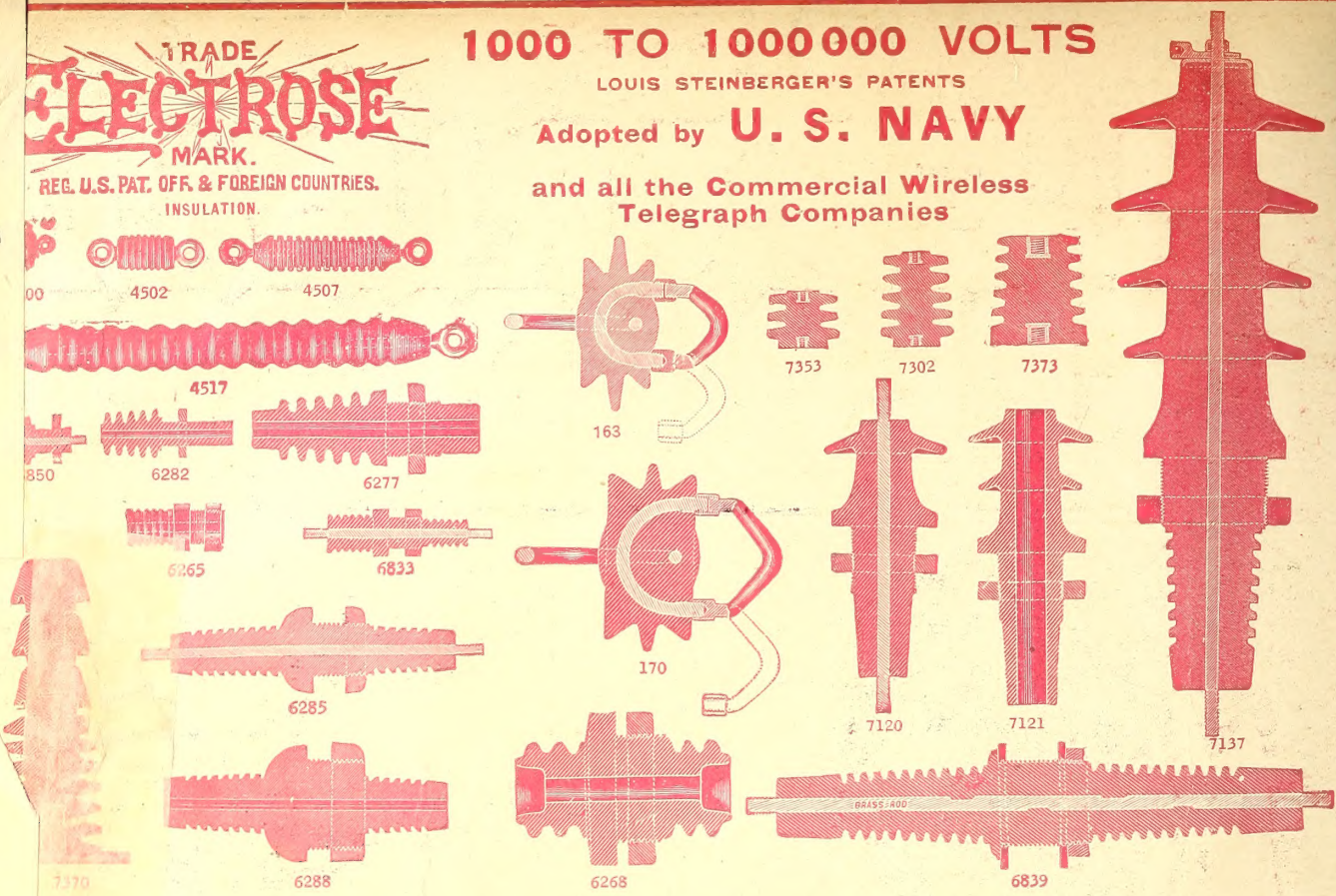
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VOL. III. WHOLE NO. 25. MAY, 1915 NUMBER 1.

Music In Colors

WHEN we go to the theater we have all probably noticed the wonderful effect that different colors play on the total effect produced on us by a certain stage setting or musical number.

A new device has been tried recently in Carnegie Hall at New York to give "color music," as it may be termed (see Fig. 1), and a special piece of music was prepared for this device by the composer, Scriabine, and produced as part of the piece, "Prometheus."

The "color organ" instrument has a keyboard of 12 colors, red, rosy-orange, yellow, green, pearly blue, "the shimmer of moonshine," bright blue, violet, purple, steely, "steely with the glint of metal" and dark red.

The composer's dream was to build a palatial theater so contrived that the audience should be bathed in rhythmical light as it listened to the music.

Modest Altschuler, conductor for the Russian Symphony Society, described the effect of the color music on the new instrument as "intoxicating," and said that if the instrument proved to be a valuable accompaniment to an orchestra, scores for it could be written so that it could be used for other pieces.

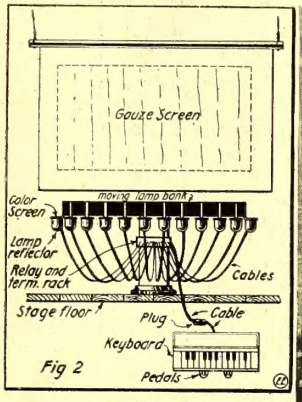


Fig. 1. As Various Notes and Chords Are Played Corresponding Colors Are Projected Upward Through Gauze Screens as Shown. Color Organ is Controlled by Keyboard and Pianist at Right. Fig. 2 Shows Details.

Note musician playing color music keyboard at right.

Simply described, the musical color scheme is worked out as follows: For every changing mood in the music a different color is taken, as given for a certain note, etc., and which color also represents as near as possible the feeling of the soul, so to speak.

We show diagrammatically at Fig. 2 how this light effect is managed. This device was built on short notice under the guidance of Preston S. Miller, of the Electrical Testing Laboratories, New York, and therefore future installations may be wonderfully improved. Referring to the diagram, a continuous band of high power tungsten lamps are caused to move half way around the belt circuit, and back again continuously; as long as the *color notes* are being used.

Flexible insulated cables connect to each lamp as seen, and over each tungsten lamp is fitted a color screen.

Over this "color organ" is placed a frame about 12 by 15 feet at the front opening. In this frame are placed several pieces of various kinds of fine transparent gauze, which hang slightly in folds. This scheme, combined with the always moving and intermixing bands of color as projected upward, forms a wonderful effect.

The keyboard, which is similar to a piano, can be played by any pianist, the musical score being written in regular notes on ruled paper, the same as any music. Color intensity variation is obtained by means of two foot pedals at the base of the keyboard. Hence the wonderful range of colors and tints possible is evident.

In laying out this musical color scheme the composer of "Prometheus" made use of an arbitrary color scale, as might be suspected. Rimington had previously worked out an equivalent system for this purpose, but the new arrangement was as follows, the tone notes being:

C ..... Red.
D ..... Yellow.
E .....Pearly Blue.
F-sharp ..... Blue
A ..... Green.
B-flat .....Steely Gray.

And so on. Various combinations of these colors were made easily possible by the keyboard, which resembled piano keys, and thus it was easy for the player to strike a chord, the same as in ordinary music.

The operation of the keys and lamps is not direct but indirect, to avoid handling any heavy currents at the keyboard. The keys when depressed close a direct-current circuit through corresponding relays mounted on the central supporting column, shown in the diagram, Fig. 2. The foot pedals control the intensity of the light and operate an adjustable impedance coil in the 110-volt alternating-current circuit feeding the moving tungsten lamp band.

The lamps were all specially made with concentrated filaments to project the maximum amount of light upward through and on the gauze screens. The lamps were made up for this work through the courtesy of the General Electric Co. The necessary color screens were placed in slides over each lamp reflector, and colored gelatine was largedly used for this work, placing it between two clear glass plates. For such colors as red, a plain red glass was used.

The great success of the effect produced with this device was due in great part to the ingenious arrangement of the gauze screens. The most flimsy screens came first, then next heavier gauze, etc., ending up with a rather stiff and coarse mesh netting. The color effect on the audience was quite marvelous indeed, as the different, always-changing colors were really seen through each other.

"The Electrical Experimenter" is published on the 15th of each month at 233 Fulton Street, New York. There are 12 numbers per year. The subscription price is 50 cents a year in U. S. and possessions. Canada and foreign countries 75 cents a year. U. S. coin as well as U. S. stamps accepted (no foreign coin or stamps). Single copies 10 cents each. A sample copy will be sent gratis on request. Checks and money orders should be drawn to order of the Experimenter Publishing Co., Inc.

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All communications and contributions to this journal must be addressed to: Editor, "The Electrical Experimenter," 233 Fulton Street, New York. We cannot return unaccepted contributions unless full return postage has been included. ALL accepted contributions are paid for on publication. A special rate is paid for novel experiments; good photographs accompanying them are highly desirable.

Entered as second-class matter at the New York Post Office, March 1, 1915, under Act of Congress of March 3, 1879. Title registered U. S. Patent Office. Copyright 1915 by E. P. Co., Inc., New York. The Electrical Experimenter. Monthly. Published by the Experimenter Publishing Co., Inc., 233 Fulton Street, New York.

Baron Münchhausen's New Scientific Adventures

By Hugo Gernsback

I Make a Wireless Acquaintance

MY name is Ignaz Montmorency Alier. If that don't suit you I suggest I. M. Alier for short. I am a Yankee by birth; no doubt you guessed that much. Both my father and mother came over on the Mayflower and settled in Yankton, Mass., where they are engaged at present in cactus and ostrich farming. Ever since I was a little boy my father, for reasons best known to himself, begged of me to be a worshipper of truth, no matter how painful it might prove. I am glad to say that my father's teachings fell on fertile territory. I have never knowingly uttered an untruth. The pursuit of truth since I have grown up has become a mania with me, so much so, in fact, that even an every-day exaggeration made by best of friends drive me frantic. understand my liar peculiar state of mind, as far as truth is concerned, it will probably be best understood by the average layman if I say that truth with me is nothing less and nothing more but a hobby—a sort of sport, if you wish. I collect truthful statements as you would collect stamps. Particularly beautiful and original examples of truth are written down by me on large white cards. These cards are all indexed and classified and kept, vertically filed in card drawers. The originator (may I say inventor?) of these truths is, of course, given full credit on these cards, so that it is easy to find in years gone by who made this or that particular truthful statement. You will not think me immodest if I state in passing that nine-tenths of the cards contain my own name as originator of original and surprising truths. Of course, as truth is a science with me, such a statement cannot cause much surprise; I realize this fully.

I would not think of taking up your valuable time with the above statement were it not so vitally necessary for me to fully acquaint you with my character, for reasons which will be more apparent later. For this reason I also find it quite necessary to give you the following references; any of the below mentioned individuals and institutions will be only too glad to vouch for my integrity, honesty, as well as veracity.* I could give almost an indefinite list, but I prefer mentioning only the following:

Hiram O'Rourke, lawyer, Yankton, Mass.
(The above defended me in three breach of promise suits, as well as eight perjury charges of which I was accused.)

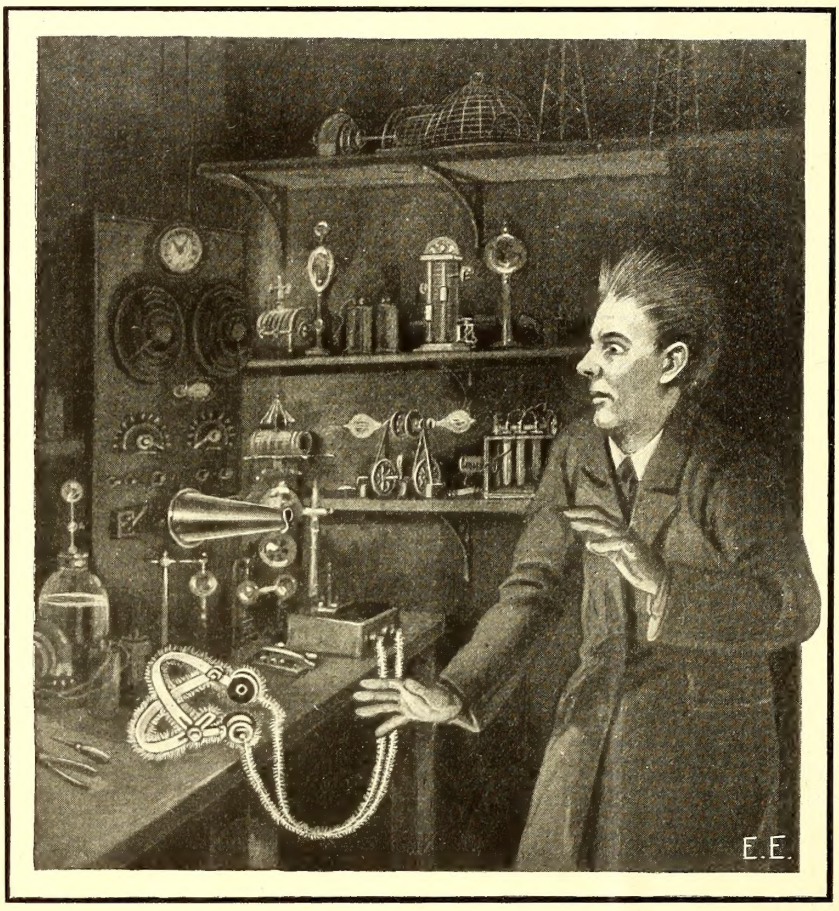
Patrick Flanagan, jailkeeper, Yankton, Mass.

Jeremiah Addlecock, jailkeeper, Coffeeville, Me.

Mike Whiffeltree, jailkeeper, Lyreville, Vt.
(The latter only knew me intimately for five months.)

The Ananias Club, Yankton, Mass.

Now that I have thoroughly established my standing I will proceed, and I sincerely hope and trust that no one will question any statements I may be called to make in these pages. They are the bare, unvarnished truth in each and every case. If called upon I will cheerfully swear to the truth of any of my statements before a notary. (I am a notary myself.)



* * * the Receivers Suddenly Became Enveloped in a Scarlet Phosphorescence, Glowing Softly Like the Light in an X-Ray Tube.

As every resident of my home town knows, I own the largest wireless plant in the State. I own the only long distance wireless telephone station in the country. As is known, I hold the long distance wireless telephone record of the world. Already in 1900, when my set was not nearly as perfected as it is to-day, I could talk around the world and converse freely with myself, the message traveling clear around the globe. This fact was described at length in "The London Scientific Gazette of 1900." (See Vol. XX, No. 19, page 39.) It attracted much attention at the time, but it was declared commercially impractical, for the reason that it was argued; if it is necessary to build a giant wireless station at a tremendous expense in order to talk clear around the globe, for the sole purpose of listening to one's own voice, why not talk to yourself without the expensive wireless? My critics contended that it would be far less expensive and perhaps more satisfactory.

Of course, this argument, quite logical as it was, for the time being discouraged me not a little, but soon I took up my studies anew and made many important new discoveries.

As president and founder of the now defunct *American Wireless Mouse Trap Co.* I learned a lot about rats and mice and this knowledge even to-day is of high importance to me.

The above company, as will be remembered by many, operated at one time no less than 80,169,509 wireless mouse traps all over the country. If we had not been so eminently successful in killing every mouse and rat in the country the company would, no doubt, be still in business. As it is, the American public calls me its greatest living benefactor for ridding the country of these pests, and this alone is honor enough and cannot but speak well for me. For the benefit of my young readers who never saw one of my wireless mouse traps let me give a brief description of same.

Each trap was constructed like a squirrel cage. The opening to the cage was fashioned in such a manner that a mouse or rat could get in it, but not out of it of its own accord once in it. Now, as anyone can readily convince himself by trial, mice and rats are exceedingly fond of revolving cages. They will travel for miles to get one. It has a most powerful fascination for them. They simply adore it and go wild about it. I am almost tempted to say that they go crazy about it, for they find it extremely hard to stop once they start running. Upon this great natural law I based my invention.

The shaft of the cage was connected to a little dynamo, which was operated at high speed as soon as the mouse or rat started the cage revolving. The dynamo in turn was connected to a little wireless set and this in turn to an aerial wire system on the roof of the house. The wireless set was constructed in such a manner that when operated it would send out a call similar to a Western Union call box. In each locality we had a wireless "central" with operators. As soon as one of the operators received a call he would look up his call book and see where the call originated. This took but a few seconds. A man would then be dispatched immediately to the house in question, where he would brain the mouse or rat on the spot, single handed, by means of a club. He would next reset the trap and return to headquarters, giving a full itemized report of the case. To the inexperienced my system of killing the rodents might appear rather long winded and expensive, but it is here where my in-

*On account of the numerous inquiries received concerning me I suggest to enclose a 2-ct. stamp for your reply when writing.

sight into human nature came to its full bloom and made me famous.

Not everybody likes to kill rats and mice. This is particularly true of the feminine humans inhabitating this globe. Why this should be so I do not profess to know absolutely, although I have some vague opinions on the subject, which, however, I would rather keep to myself. Suffice it to say, bipeds in skirts rather employ their time otherwise than catching, not to mention, killing rats and mice. What, therefore, I ask was more natural for me than to employ professional ratters and mousers, to perform the disagreeable tasks? At any event, you may be sure, the company was a huge success and many a fair damsel even to-day sends me highly perfumed letters hailing me as the liberator of the fairer sex's arch-enemies.

But this brings me away from my story. As I said already, I own the largest wireless telephone station in the country. It is exceedingly well appointed and contains instruments and apparatus of which the greatest living scientists have as yet not the faintest knowledge.

This story starts on a bitter cold December night. I could go to some length by writing two or three columns at two cents a word, stating how the wind sang weirdly through my aerial wires on the roof; how the flames of my log fire cast fantastic shadows about the room; how my cat was softly purring on a chair near by, dreaming of some long departed appetizing canary; how the windows rattled uncannily in the storm; how the trees moaned plaintively outside, and so forth. Thus I could set the scene and prepare you for the story—getting you under tension, as the editor calls it technically.

As a plain matter of fact, however, the aerial wires were full of sleet and therefore could not "sing," furthermore I was glad that they didn't come down, which would have made some music, although not very pleasant music. Then the log fire, too, could not very well have cast fantastic shadows either, nor any other shadows for that matter, because the log fire happened to be a radiator. Instead of casting fantastic shadows, however, it cast a lot of . ink noise about and every now and then made me jump clean out of my chair. Then, also, the cat could not have purred very readily on the chair because it wasn't a cat at all, but a dog to begin with, and he could not have purred even if he had taken lessons at $5 an hour. There were, however, good reason for this, too. Firstly, it was not a he; it was a she. Secondly, she had been dead for two years and only because she was stuffed so nicely did I keep her. Thirdly, she could positively not have sat on a chair near by, simply because there was only one chair in the place and I was on it. Fourthly, dogs, especially dead dogs, are not known to dream about appetizing canary birds. Then, too, the windows could not have rattled in the storm where I was, for my wireless station is in the cellar and that cellar has no windows whatsoever. As for the trees moaning or not moaning I explained above that my people were engaged in cactus farming. There are no trees on the farm, and cactus does positively not moan in a storm. It squeaks.

Now that you understand the situation fully I will proceed. It was after 12 o'clock midnight on a cold winter night. My new, loud talking telephone receivers were on my head and I had just lit a fresh pipe. I had been flirting with my vario-selective coupling-balance which was adjusted to a very long wave length—96,000 meters, if my memory serves me right—and I was just in the act of tuning down to the wave length of *F. L.*—that's the Paris Eiffel Tower—when suddenly I heard a peculiar sound. Through my receivers came a very faint, but exceedingly high pitched screaming sound, which became louder and louder each second. While I was still wondering what this unearthly sound could be, I suddenly heard in a faint but clear voice:

"Alier, Yankton, Mass.—80,000 meters." This sentence was repeated several times. I lost no time in starting my 200 K. W. generator, tuned up to 80,000 meters, and yelled into the transmitter in front of me.

"Ship ahoy! This is Alier of Yankton, who's there?" Almost instantly it came:

"It is I, Hieronymus Karl Friedrich Baron Münchhausen . . . ."

At that I almost swallowed my pipe, but just the same, the colossal nerve of that fellow aggravated me.

"You confounded liar, stop your joking," I yelled back, "if you have to say anything, say it and be quick about it, for I am going to bed in a few minutes."

"My son," it came back in sepulchral tones, "I am not at all surprised at your astonishment. Rest assured I expected you would doubt my identify. However, I have proofs. It is now 12.50 a. m. terrestrial time. Kindly mount to the top of your roof. You will find it to be a clear night, the moon being half full. Take your watch along and observe the moon carefully. Precisely at 1 a. m. I will illuminate the dark half portion of the moon with a red phosphorescence, three times beginning 1 a. m., each illumination to last five seconds with a 10 second interval between each illumination. After this return to your phones. I have spoken. . . ."

The peculiar high pitched screaming sound was heard once more in my receivers. It ran rapidly down the scale, became fainter and fainter—there was a low click in my 'phones and everything was quiet.

I must have sat dumbfounded for at least a minute before I could recollect my senses. I took the 'phones off my head and wiped off the perspiration mechanically. I am sure I was dazed. I looked at my hands, moving them back and forth before my eyes, but I wasn't certain then that I was awake. So I took a pin laying near by and shoved it in my thigh. I knew then that I really was awake. I wanted to think, but I had to laugh outright. Why, the thing was preposterous. Some practical amateur joker, no doubt, who tried to get me on the roof and then afterward have me the laughing stock of the town.

"Good stunt! Rather novel idea, ha, ha! . . . But that sepulchral, earnest voice, that distinct accent, the peculiar intonation . . . could it?" . . .

My eyes fell on the clock before me. It was 12:55. At that very moment my 'phones emitted a loud crackling sound, like "static" before a thunderstorm. As I was looking on wondering, the receivers suddenly became enveloped in a scarlet phosphorescence, glowing softly like the light in an X-ray tube.

I know now that my hair must have raised at the sight of the uncanny phenomenon. I recollect that I grabbed my cap and run up the stairs, knocking somebody down as I flew by, pushed the trap open and sank down on the roof almost exhausted. Mechanically I pulled out my watch. It was 11:59. I shivered and looked intently at the moon, sailing in a beautifully clear sky, in which the stars sparkled with unusual brilliancy.

The moon was half full, the dark half being jet black and undistinguishable from the black sky. A clock near by started to strike 1 o'clock. The sound was still vibrating in the air when I witnessed a most remarkable phenomenon. The dark portion of the moon was suddenly faintly illuminated with the same scarlet phosphorescence which I had seen but a few seconds before around my receivers.

It seemed to me as if there was a gigantic searchlight stationed on the bright side of the moon, throwing a colossal shaft of that scarlet light over on the dark side. This shaft of light was not stationary, but it swept rapidly back and forward over the dark face of the moon, illuminating the moon's craters in a wonderful fashion. The phosphorescent light shaft was so long that it went actually clear across the face of the moon and swept out into the space beyond for a considerable distance. It was the most magnificent, inspiring spectacle I had ever witnessed in my life. Suddenly the light vanished for a short period, just as the mysterious party had said it would. I counted to 10. Just as sudden the sweeping light shaft appeared anew brushing the moon's dark face a few times back and forward as before. The light disappeared again; I counted to 10 and it reappeared, going through the identical motions for the third and last time.

For a few seconds I stood fascinated probably with my mouth wide open. Like in a trance, I went down to the wireless, and I still remember while adjusting the 'phones over my head that my teeth were chattering violently and that I had a cold chill which shook me from head to foot.

I had scarcely adjusted the 'phones when the high pitched screaming sound was heard again, and in a few seconds the voice with the graveyard tone spoke once more:

"I trust, my boy, that you will not doubt again Baron Münchhausen's word," here I could distinguish a low chuckle, "but tell me, how did you like my little exhibition?" "Why, your excellency," I stammered back into the transmitter before me, "I really had no idea of offending you before, the whole thing seemed so impossible to me that you can hardly blame me for doubting your words. However, after seeing your wonderful lunar fireworks I stand ready to believe anything and everything that you may say. I assure you I will swear by it. But would you be so kind to answer me the burning question which is uppermost in my mind just now? Am I not correct in my assumption that your excellency was born in 1720 in Hanover, Germany, and was buried in 1797 in the same locality?"

"Most assuredly, my boy, you have stated the facts absolutely correct. As you say, I was buried in 1797, but if you were to open the coffin to-day you would not find a bone of Baron Münchhausen. For political reasons it was very desirable for me to 'die' in 1797, for if I had not 'died' just then they would have hung me dead, no doubt. So I had a wax replica made of myself, which looked so much like my dear self that it even deceived my trusted valet, Fritz, who came within an ace of placing me in the coffin while I was sleeping peacefully but soundly in a secret room in my attic alongside of my wax figure. If I had not sneezed in my sleep they would have buried me undoubtedly and let my wax replica shift for itself in an unfriendly world. While this might have been a regrettable accident, it would have hardly affected me much, for I am immortal, as you no doubt know!" A chuckle was discerned by me at this pun, the Baron no doubt liking his own little jokes.

"However, in the absence of Fritz, that blunderer Rosskopf, the embalmer, enters the house very much under the influence of Schnapps and by pure chance finds the secret room. He sees me sleeping soundly and thinks, of course, that I am dead. He, being either too lazy or else too drunk, I never knew which, he fails entirely to cut me open and to embalm me in the usual

(*Continued on page* 10).

How We Get Our War News

A Glimpse Inside the "News" Lines. By H. Winfield Secor

THE problem of gathering and properly distributing to the various newspapers throughout the country, the latest war news, or in fact news of any character, is one of the greatest problems encountered by the Associated Press Bureau. This useful news organization has its main offices located in New York City, where it has facilities and the necessary electrical installations and circuits, enabling it to promptly receive and transcribe all the latest news from every part of the country and also from the cables across the ocean as well as long distance wireless.

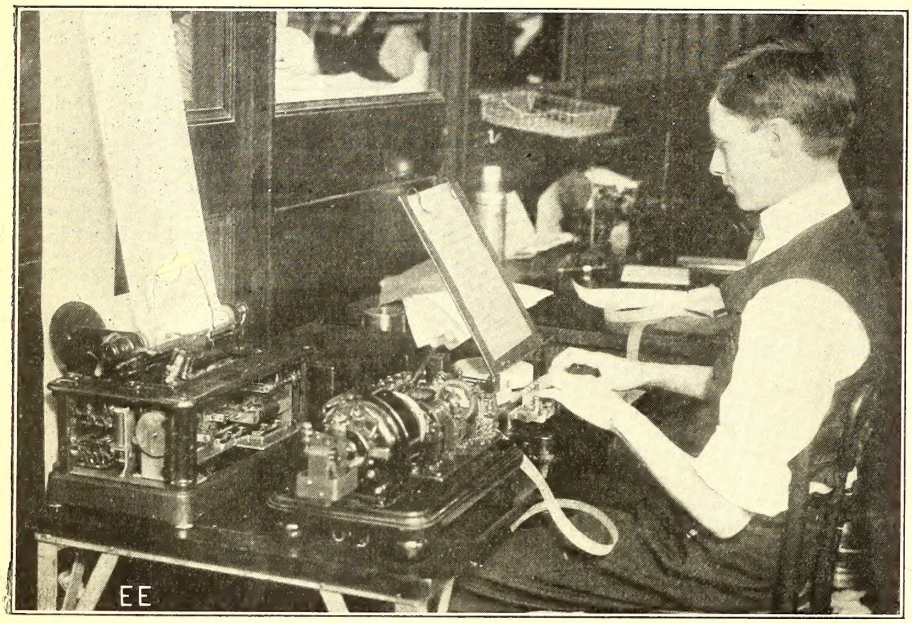
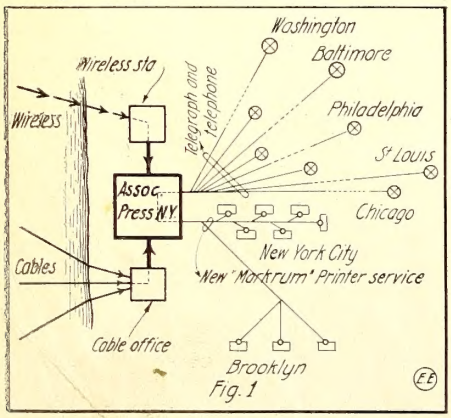


Photo (C) by Underwood & Underwood.
Showing Morkrum Sending and Receiving Printing Telegraph System Installed in Associated Press Offices in New York City. Local Printer to Left.

When the news is received in the forms of telegrams, etc.; after the news is edited, it is transmitted to the various newspapers throughout the country and city who subscribe to this press service. So far, and as has been the case for many years, the news is transmitted to outlying districts and distant cities by Morse code over the telegraph wire. However, a newly perfected transmitting system, known as the "Morkrum" arrangement, is now in use for New York City and vicinity by the Associated Press. It may be remarked to start with, that in the news transmitting office of this association, there are handled on the average 32,000 words per day.

The diagram at Fig. 1 will make clear how the network of "news" gathering and distributing lines terminate in a common clearing house, or as we know it, the Associated Press. Cables and radio bring in the news from across the ocean, while telephone and telegraph serve to handle the land "news" service.



How the Associated Press Gathers and Distributes "News" From New York City as a Center.

With the previous arrangement and making use of Morse telegraph operators for transmitting this news to the various newspapers in New York and Brooklyn, it required a great many extra messengers to deliver some of the news, and also a number of Morse operators; as the average speed available by this form of electrical transmission of intelligence is rather low or about 25 to 30 words per minute.

We show herewith the new Morkrum code (Fig. 2), as used with their machines, and as seen a series of round perforations in a paper tape serve to transmit the proper sequence of electrical signals over the line to the various newspapers, to actuate a printing receiver at the end of every line. Fig. 3 shows a specimen of this perforated paper tape. This tape is prepared very quickly and easily by means of a perforator in the form of an ordinary typewriter with a keyboard exactly similar, so that any typist may with very little instruction and practice operate same successfully. By reading the rows of dots across the paper in connection with the code here given, the reader can very easily decipher the meaning of the news item included on this particular piece of tape.

We show herewith also illustration of the transmitting and receiving instruments of the Morkrum pattern and two of the transmitting instruments are now in use in the Morkrum transmitting room of the Associated Press. These two instruments work simultaneously sending out news over a common circuit of two wires. Whatever papers require the news at the particular moment are switched on to the transmitting circuits by means of a plug and jack switchboard, similar to that used in telephone work. Means is provided for the attendant at each receiving station to notify the sender of trouble with the machine.

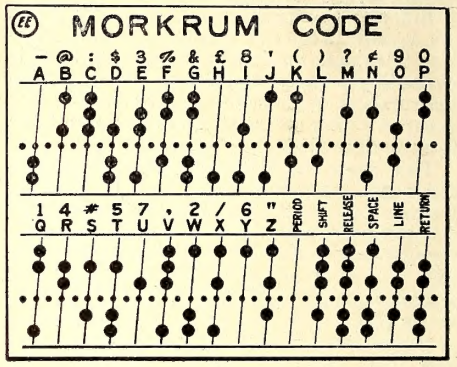


Fig. 2.
The New Morkrum Automatic Printing Telegraph Code.

The instruments are of the very finest workmanship, of course, and work with lightning rapidity and precision. The transmitter in the form of a typewriter as already mentioned, also includes the transmitting battery of polar relays; to the number of 12, which successively send out at high speed, the necessary positive and negative electrical impulses over the line to the receiving printers. As soon as the end of a printed line is reached a red light glows under the keyboard of the transmitter. The operator then presses his shift key for line spacing as many times as the printed lines are to be spaced apart. At each transmitting station, a local printer is simultaneously operated so that all of the messages sent out can be checked or watched to see that the spelling is correct and that one line is not being printed over another, etc.

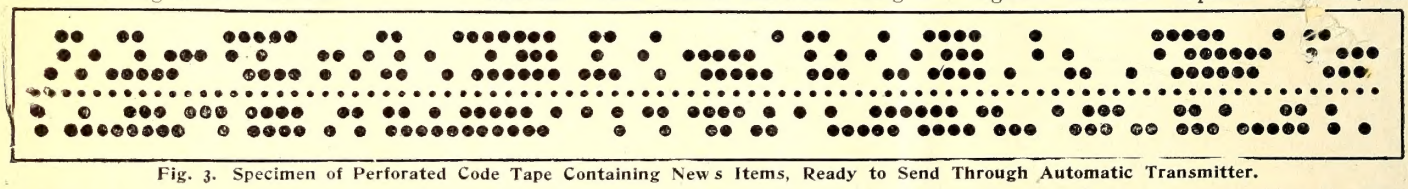


Fig. 3. Specimen of Perforated Code Tape Containing News Items, Ready to Send Through Automatic Transmitter.

As the speed of this system is much higher than that available when ordinary Morse telegraph instruments are utilized and when the greatest rush of news occurs; which is, by the way, about 11 a. m. to 1 p. m. each day; it is generally the case that three operators or more perforate the tapes simultaneously, as these tapes can be passed through the transmitting machines at very high speed, say 60 to 70 words per minute and more. It is thus seen that two transmitting keys using this tape, can take care of as many as four operators. The received news at each station is printed in type on a continuous paper roll about eight inches wide. It is detached from the printer as the machine feeds it out.

Electricity and Nature—A Thunderstorm Primer

(Concluded)

What is Voltaic electricity?

Voltaic electricity is the electricity that is developed during *chemical changes,* and is so called after Volta, who enlarged upon the theory of Galvani.

What are the differences between mechanical, or friction electricity, Voltaic electricity, Galvanism, and magnetism?

Frictional electricity is electricity *sud-*



The Aurora Borealis or "Northern Lights." Believed to Be of an Electrical Nature.

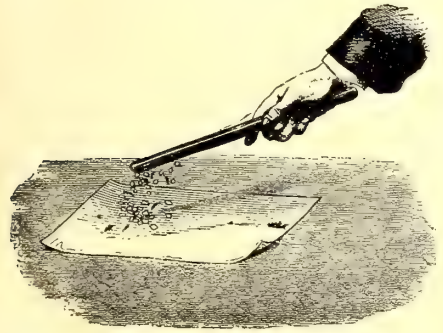
denly liberated under the effects of the *motion,* or the mechanical disturbance of bodies.

Voltaic electricity is a *steady flow* of an electric current, arising from the *gradual changes of chemical* action.

Galvanism and *Voltaic* are also *identical,* since the latter is founded upon, and is a development of, the former. But the term *Galvanism* is frequently used when speaking of the development of electricity in *animal bodies.*

Magnetism is the electricity of the *earth,* and is also understood to include the *fixed electricity of terrestrial bodies.*

Man knows not *what electricity is;* yet by an attentive observance of its *effects,* he avails himself of the power existing in an unknown source, and produces marvelous results. When the Grecian philosopher, Thales, sat rubbing a piece of amber, and watching the attraction of small articles of matter to its surface, he little knew of the mighty power that was then whispering to him its offer to serve mankind. And when Franklin, with the aid of a boy's plaything, drew down an electric current from the clouds, and caught a spark upon the knuckles of his hand,



Illustrating the First Principle of Electricity. The Electrified Stick of Sealing Wax.

even he little conjectured that the time was so near when that strange element, which sent its messenger to him along the string of a kite, would become one of man's most submissive servants.

So many great results have sprung from the careful observation of the simplest phenomena, that we should never pass over inattentively the most trifling thing that offers itself to our examination. Nature, in her revelations, never seeks to *startle* mankind. The formation of a rock, and the elaboration of a truth, are alike the work of ages. It was the simple blackening of silver by the sun's rays which led to the discovery of the *chemical agency of light.* It was the falling of an apple which pointed Newton to the discovery of the *laws of gravitation.* It was the force of steam, observed as it issued from beneath the lid of a kettle, that led to the invention of the *steam-machine.* And it is said of Jacquard, that he *invented the loom* which so materially aided the commerce of nations, while watching the motions of his *wife's fingers,* as she plied her knitting. As great discoveries spring from such small beginnings, who among us may not be the herald of some great truth—the founder of some world-wide benefaction?

That the area of discovery has not perceptibly narrowed its limits, is evident from the fact that the greatest elements in nature are still mysteries to man. And though it may not be within the power of a finite being to unravel the chain of wonders that enfold the works of an infinite God—still it is evident, from the progress which discovery has made, and from the good which discovery has done, that God *does* invite and encourage the human mind to contemplate the workings of Divine power, and to pursue its manifestations in every element, and in every direction.

The wonderful force of *electricity* astonishes us the more when we view it in contrast with that equally wonderful element, *light.* We have seen that light travels with a velocity of 186,000 miles in a second, but that it falls upon a delicate balance so gently, that it produces no perceptible effect. As far as we know the nature of *electricity,* it is even *more etheral* than *light;* yet, while the *ether of light* falls harmlessly and imperceptibly—even with the momentum of a flight of *ninety-five millions of miles,* the *ether of electricity,* bursting from a cloud only *five hundred yards* distant, will split massive stones, level tall towers with the dust, strike majestic trees to the ground, and instantly extinguish life of man! *Why* does *the one ether* come divested of all mechanical force, while that which seems to be *even more etheral* than it, is capable of exerting the mightiest force over material things? Does it not appear that the Creator of the universe has established these paradoxes of power to testify his Omnipotence—to show to man that with Him all things are possible; and that, in the grand cosmicism of the universe, every attribute of Omnipotence has been fulfilled?

Let us now consider man's relation to this Omnipotence. He sees that electricity smites the tall edifice, and observes that in doing so it displays choice for a certain substance through which it passes harmlessly, and that its violence is manifested only when its path is interrupted. Man, taking advantage of this preference of electricity for a particular conductor, stretches out an arm of that substance, and points it upwards to the clouds; electricity accepts the invitation, and passes harmlessly to the earth. But this is not all; man learns by observation that electricity resides in all matter; that it may be collected or dispersed; that it travels along a good conductor at the rate of a *fifth-of-a-million of miles in a second of time;* he constructs a battery, a kind of a scientific fortress in which he encamps the great warrior of nature; and then, laying down a conducting wire, he liberates the mighty force; but its flight must be on the path which man has defined, and its journey must cease at the terminus which he has decreed where by a simple contrivance of his ingenuity (the movements of a magnetic needle), the electric current is made to deliver whatever message of importance he desires to convey. Thus, the element which in an instant might deprive man of life, is subdued by him, and made the obedient messenger of his will!

TO AVOID DANGER.

Why is it necessary to avoid proximity to water and streams during lightning?

Because water being a good conductor, a person standing near it, being also a good conductor, might determine the discharge.

Why is the middle story of a house the safest part to be in during an electric storm?

Because lightning sometimes *passes upward from the earth;* hence it is a mistaken notion of safety to take refuge in a cellar. In instances where houses have been struck with electricity from the earth, the force of the shock has abated as the electricity ascended.

Why is the middle of a room the safest place?

Because it is removed from *conducting surfaces,* such as bright mirrors, bell-wires, walls, cornices, etc.

Why is it advisable to stand on a thick hearth-rug or on a hair mattress?

Because, being dry, and non-conducting bodies, they would *insulate the human*



Showing the Effect of the Union and Separation of the Charcoal Points.

body, and prevent the electricity from passing to it.

Why is it dangerous to approach the fire-place in an electric storm?

Because the heated air, smoke, vapour and soot act as conductors.

Why should a person riding in a carriage during a thunderstorm, sit upright?

Because electricity may pass through the sides or back of the carriage.

The rule should be observed to avoid all *elevated* objects, which, as well as being elevated, are of a *slow conducting* character. The advice has been frequently given to avoid the neighborhood of conducting bodies; but when those bodies offer *perfect conduction* they convey electricity to the ground. Thus, to stand by or be within a church or lofty building, *properly fitted with lightning conductors,* is far safer than to stand near a tree, or a lofty building, *without a lightning conductor,* because electricity always seeks *the best conductor,* and the human body being a better medium than either a tree or a house, electricity would fly to it, even though it may first have seized upon one of the other objects. It must not be supposed that churches and houses having lightning conductors are not touched by electricity because no shock is felt or witnessed; their lightning rods are continually facilitating the movements of electricity, and probably passing, harmlessly, currents which, if resisted, would shatter the edifices to pieces.

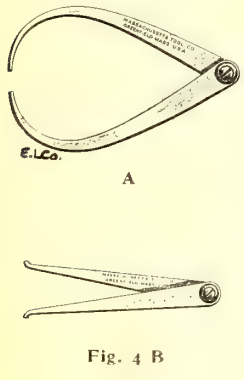
(*Continued on page* 10.)

Experimental Electricity Course

S. Gernsback and H. Winfield Secor

LESSON 20.
HOW TO MAKE THINGS
(Concluded.)

Tap numbers each correspond to certain decimal parts of an inch, and can be found in any tap or drill catalog. A few of



A

Fig. 4 B

Inside and Outside Calipers



Fig. 6
Small Drill Press



Fig. 5
Hack Saw

the common tap numbers and their inch equivalents are cited below (Kent):

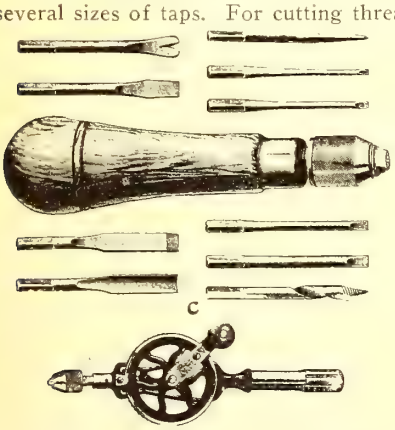
Tap or screw number.	Diameter of body of screw. (Max. diameter.)
No. 2	.0842"
" 4	.1105"
" 6	.1368"
" 8	.1631"
" 10	.1894"
" 12	.2158"
" 14	.2421"
" 16	.2684"
" 18	.2947"
" 20	.3210"

As seen from the above, No. 14 size tap is slightly smaller than ¼ inch, hence it is nearly the same whether ¼"—20 pitch or No. 14—20 pitch is designated; but a ¼"—20 machine screw fits into a hole tapped with a No. 14—20 tap pretty snugly, and the exact designation should always be watched and adhered to.



Fig. 7 A

For tapping threads in holes a tap, Fig. 8 A, is utilized in a tap wrench or holder B. The holder has an adjustable chuck taking several sizes of taps. For cutting threads on rods, etc., a steel die and holder, Fig. 9, is employed. In drilling and tapping cast iron no oil is required. For working wrought iron or steel oil is always used. Brass, aluminum, or any other metals require oil for drilling and tapping of any considerable extent.



C

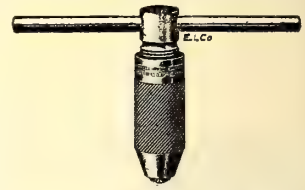
Fig. 7 B

A vise is essential in all shop work, and a neat one capable of being clamped to a table top is seen at Fig. 10.

A most useful machine is the lathe, upon which any shape of wood, fiber and brass may be turned up, and a good one for the amateur cost but little. A pair of heavy scissors, known as tinner's snips, are very handy for cutting out sections of thin fiber, tin, sheet iron, etc., not exceeding 1/16" thick.

For laboratory or shop use, in heating joints to be soldered, brazing and innumerable other operations, the Bunsen gas flame shown at Fig. 11 is a valuable asset. It uses the regular house gas, and by a set of air holes at the base transforms the flame into a strong blue one of intense heat, instead of the yellowish flame of low heat emitted by the usual tip.

For driving screws use is made of a plain or ratchet screw driver. A pressure exerted on the handle drives the screw or removes it, according to how the mechanism is set by the button on the side of it. This is a great time saver where many screws have to be placed.



B



Fig. 8 A

Wrenches of various kinds are used to handle rods, nuts and the like, a Stilson wrench for handling pipe, etc., being very useful—also for fitting round rods of any kind.

Muriatic acid cut by dropping bits of zinc in it may be employed as a flux to solder iron with, but for soldering electrical joints on copper wires it should never be used, only the non-acid fluxes such as rosin, being permissible.

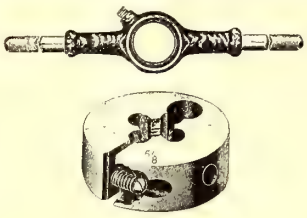


Fig. 9
Thread Cutting Die and Holder

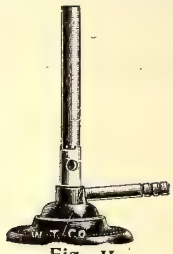


Fig. 11
The Bunsen Burner

Fig. 12 depicts a speed counter for taking the speed in revolutions of shafts, pulleys, etc. The speed of a belt driven shaft is dependent upon the proportion existing between the diameters of the driving and driven pulleys. Briefly expressed, it is as follows: The speed of one pulley, A, is equal to the product of the diameter of the other pulley in inches (say we call it B), by the revolutions per minute it makes, divided by the diameter of the pulley A, in inches, the result being in revolutions per minute (R. P. M.).

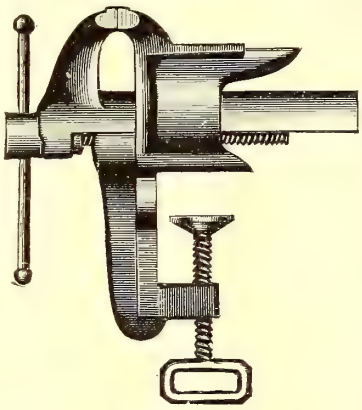


Fig. 10
Bench Vise

The speed ratio of gears is found by dividing the number of teeth on the large gear by the number of teeth on the smaller one. For example, suppose one gear had 100 teeth on it and the smaller one 12 teeth, then the ratio of speed would be 8 to 1, or the smaller gear wheel would make eight revolutions to every one of the larger gear. *(Finis.)*

PHOTOS OF MAGNETIC FIELDS.

An improvement on the method suggested by Mr. Hymes (February issue, page 148) for photographing magnetic fields is found in the use of blue-print paper in place of Velox.

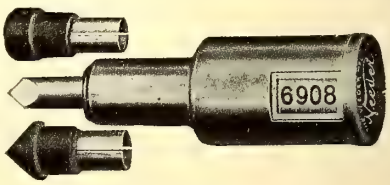


Fig. 12
Speed Counter

The blue-print paper is easy to manipulate, requiring only washing in water to fix the image, and is also not subject to fogging from premature exposure to ordinary sunlight. This makes its use more convenient.

When purchased in large pieces the paper can be obtained at 20 to 30 cents per yard, which is a very important item where a number of prints are to be made.

Contributed by S. KRAUSE.

INDIANA RADIO AMATEURS: ATTENTION!

I am trying to get on foot a plan to unite the amateurs of the 8th and 9th Radio Districts within 100 miles of Angola, Indiana. I wish all amateurs who are interested would communicate with me. Yours truly, Leo B. Wilcox, 415 W. Park Ave., Angola, Ind.

Interesting Experiments in Electricity

By P. Mertz

No. 1. An Electric Pump

THIS pump is a purely electromagnetic one, and although it is extremely weak, nevertheless it is very interesting as a curiosity.

Referring to Fig. 1, A is a tin can; almost any size will do very well. In the bottom of the can is put a disc (B) of mica, celluloid, hard rubber or any insulator which is not affected by being immersed in water. C is as powerful a bar magnet as can be procured; it is better if it is of circular cross-section, as it will not interfere so much with the motion of the water.

A solution of copper sulphate in water is to be poured into the can. The terminals of a fairly powerful source of current (D) are then connected, one to the tin can (A) and the other to the bar magnet (C). As soon as the current is turned on the water will be observed to begin to turn around the bar magnet. If little pieces of paper, wood, etc., are dropped in the water the motion will be more easily seen. If the direction of the current in the water is reversed the latter will turn in the opposite direction. With a strong bar magnet and current the water will rotate at a pretty good speed. If the water rotates very slowly, or not at all, due to the current not being strong enough, this can be remedied by using a can of less diameter, so that there will be less water to move.

Although this apparatus is hardly worthy of its name as a pump, it is easily seen that the centrifugal action of the water as it rotates in the can suggests a somewhat more real pump.

The motion of the water can easily be explained from the diagram, Fig. 2. The current as it crosses from A to C encounters the magnetic lines of force of the magnet in such a way as to produce motion around the latter.

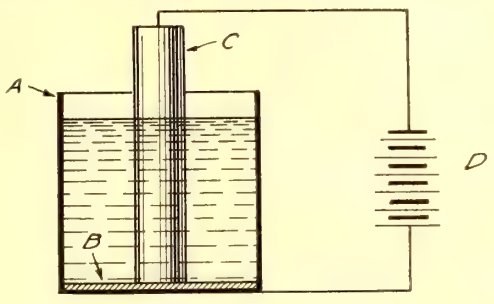


Fig. 1.

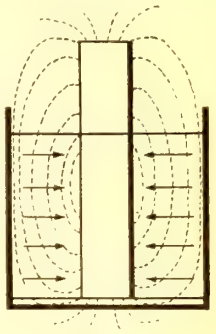


Fig. 2.

Diagrams Showing How a Copper Sulphate Solution Will Rotate Due to the Whirling Magnetic Field About a Conductor.

No. 2. A 500-Volt Dry Cell.

This dry cell, although having such an enormously high voltage, nevertheless occupies a space of only about 8x1½x1½ inches, and is as dry as the atmosphere which surrounds it.

It is made of a great number of thin paper washers about 1½ inches in diameter, painted on one side with aluminum paint and on the other with gold paint. As illustrated in Fig. 3, they are strung on a ¼-inch hard rubber rod, great care being taken to see that the aluminum sides of all the washers face one direction and the gold sides the other. The washers are compressed together between two metal washers, each under a nut screwed over the end of the hard rubber rod.

This forms a voltaic pile, the aluminum and copper faces, respectively, acting like the more usual zinc and copper discs, and the paper with the slight trace of moisture it gathers from the surrounding atmosphere, as the usual cloth wet with acidulated water. The extremely small amount of moisture is quite sufficient for generating the extraordinarily high (for a dry cell, at least) potential. The voltage of the cell can easily be tested if one end of it is grounded and the other touched to an electroscope. It will be noted, however, that the electroscope will take some time before deflecting, on account of the extremely minute current, which cannot charge it very rapidly. This current is so small that even a rather sensitive galvanometer cannot readily detect it, unless the diameter of the paper washers is quite large and they are quite moist.

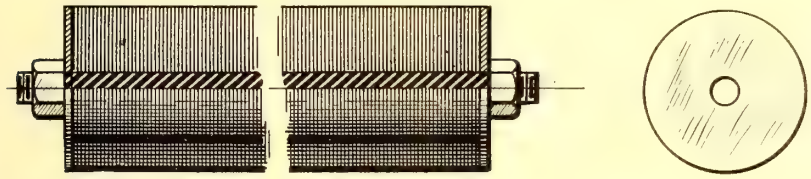


Fig. 3.

A 500 Volt "Dry Cell" Built on the Principle of the Voltaic Pile.

No. 3. The Electric Snake.

This is simply an iron tripod stand of the kind used in physics experiments (as shown in the illustration, Fig. 4), over which a solenoid has been slipped so as to make a magnet of it. At the top end a clamp is fastened to hold one end of a very flexible conducting cord, the other end of which is fastened to a screw, or whatever is handiest, on the top wooden end of the solenoid. The cord is connected in series with the solenoid with a fairly strong current, and a reversing switch is inserted in such a way as to be able to reverse the current in the cord without affecting that in the coil. By turning the switch first one way and then the other the cord will coil around the iron support in a way strongly suggesting a snake. The current, however, has to be fairly strong to make this experiment successful.

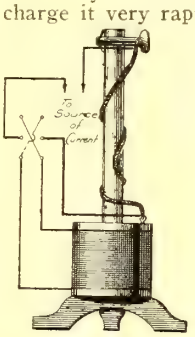


Fig. 4

Fig. 4 Shows an "Electric Snake" Experiment Easily Performed.

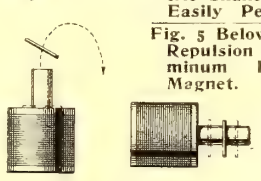


Fig. 5

Fig. 5 Below Depicts the Repulsion of an Aluminum Ring by a Magnet.

No. 4. Experiments with Induction in an Aluminum Ring.

If a light aluminum ring is slipped over one end of a fairly powerful electromagnet, such as is illustrated in Fig. 5, when the magnet is energized the ring will suddenly take a jump either toward or away from the coil. If then the current is reversed the ring will jump in the opposite direction. If the magnet is held vertically, instead of horizontally, the ring will be able to jump in only one direction (i. e., upward), but the length of jump will be increased, due to lack of friction. Indeed, if a strong enough magnet is used the ring will have no difficulty in jumping right off the magnet and landing on the floor. The experiment will be far more striking if the core of the magnet is made of a bundle of iron wires than if it is made of a solid piece.

If the magnet is energized with alternating current the ring will float in a certain position without apparent support. If disturbed from that position it will very gently and gracefully come back to it.

These experiments are especially mysterious to most because the ring is of aluminum, a non-magnetic material. The explanation, however, is simple; it is merely that a strong current (due to its low resistance) is induced in the ring, and this current generates a magnetic field, which, reacting with the field of the magnet, produces the motion.

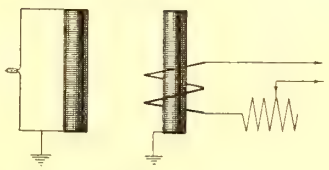


Fig. 6

In Fig. 6 Connections Are Given for a "Magic Light," Controlled by a Wave of the Hand.

No. 5. The Magic Light.

On the table are intricate apparatus resembling a wireless set and a Tesla coil. A few feet away is another Tesla coil, minus its heavy coil of wire, the fine coil alone remaining. The two ends of this coil are connected to a very small pea incandescent lamp, not lighted.

The performer turns on the switches; still the lamp does not light. He says a few occult words and waves his hands mysteriously around, and, lo and behold, it lights up! With a few more magic words and waves of his hands he extinguishes it. He then offers to blow it on. He first blows hard at it, but it does not light up; he comes nearer, blows very gently and, yielding to his coaxing, the

lamp lights up! He blows again and the light disappears from the lamp.

The electrical man in the audience is much peeved. "There are connections under the carpet," he says. The performer offers to try the experiment standing on a big board placed on the floor. He then does the same things, without the slightest lessening of his magic powers.

Various members of the audience offer more or less ridiculous explanations, but no one guesses the true one.

How did he do it? It is very simple. He had a Tesla coil rigged up with a tuning helix. The other Tesla coil was connected to the lamp, and one terminal of each coil was grounded. Just before the experiment the performer tuned the transmitter until the lamp brightened up, and then put in a trifle more inductance, just enough so that the lamp would be extinguished. Then he placed his hand near the receiver. The result of this was that the lamp circuit had more capacity than before, which raised its wave length and brought it in tune with the transmitter, lighting the lamp. When he waved his hands he brought them near the coil, and when he blew at the lamp he brought his head near the same coil. When he extinguished the lamp he merely moved away from the coil. No one ever guesses that the proximity of some part of his body to the coil has anything to do with lighting or extinguishing the lamp. When he got on the board he still had enough capacity to produce the desired effect.

The whole thing is so simple that any wireless experimenter who has a transmitting set can easily repeat it.

A NEW ELECTRIC VAPORIZER.

For deodorizing, fumigating and medicinal purposes there has just been put on the market a new electric device of extremely simple construction known as the *Vaporel*. It consists of a blown-glass bulb about the size of a 25-watt tungsten lamp and similar in general appearance, as the illustration shows. It carries a standard screw base, so that it can be used in any lamp socket.

The glass bulb carries two spiral electrodes placed about 1 inch apart, and the current completes its path from one electrode to the other, through the oil solution poured into the bulb through an opening provided. When the oil is entirely vaporized the device shuts off the current automatically, or as soon as the liquid drops below the shorter electrode.



Ingenious Electric Vaporizer, which Fumigates Room in Few Minutes.

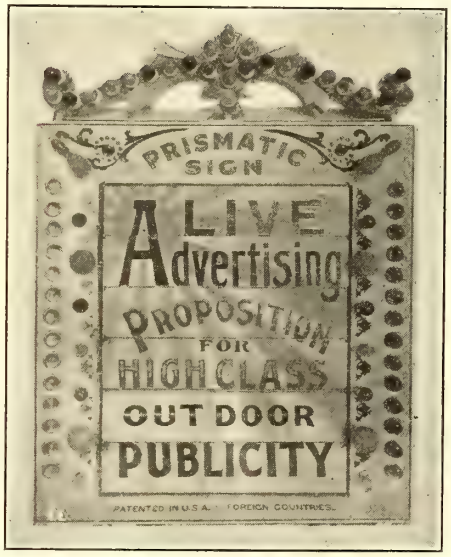
This simple vaporizing device has a wide field undoubtedly. It is recommended by physicians for inhaling or medicinal vapor treatment. Using the proper oil in it, the vapor will quickly kill the odor in kitchens, smoking rooms or any place where the air is befouled.

AN ELECTRIC MOTION SIGN.

By Frank C. Perkins.

The illustration shows a novel electric motion sign, operated mechanically and constructed of steel and iron, intended, when in register, to display a series of painted advertisements, they following each other at regular stated intervals, on a large, apparently unbroken display surface, which, in reality, consists of several separate and interchangeable parts. A unique feature obtained by this device is in that the exposed surface is made to disappear and is immediately replaced by a second surface, likewise composed of numerous units.

The change is effected very quickly and a series of four changes, following each other in regular rotation, are provided. These and other attractive results are attained by means of a series of prisms, each having four longitudinal faces and each carrying as many leaves, which are hinged to the edges of the prisms in such manner that when the prisms are at rest, all of the spaces between the prisms are closed by the leaves and the continuous surface presented alternately of prisms and leaves. The advertisement or advertisements cover the entire front surface and are, therefore, partly on the prism surfaces, and partly on the leaves.



Prismatic Electric Sign, Giving Very Spectacular Effects.

While the sign is in register for reading, there is a glare of white light brilliantly illuminating the advertisement. During act of changing from one advertising surface to another, while the white lights are off, various spectacular flash effects take place, each of the four changing periods varying in colored light effects.

It is pointed out that the possibilities for beautiful illumination are unlimited with the mechanism of this device, and at a minimum cost. By means of lenses placed around the frame, a changing color scheme is presented with only a few lamps, having the appearance of many.

It is well known that *action* is an eye magnet. An ordinary sign 20 feet by 20 feet, contains 400 square feet of painting surface. The prismatic sign same dimensions, contains *four times* as much painting surface or 1600 square feet and occupies the *same* roof space.

The journals revolve on roller bearings, thus eliminating friction to a minimum, and in conjunction with a practical reduction gearing, it requires but a very small motor. It can be used as a two-way motion sign, showing advertising from opposite directions with same set of prisms and leaves, one side being painted on reverse side of leaves only, as leaves cover the reverse side of prisms. This gives 3,200 square feet of surface.

THE NICKEL-A-SHOCK MAN.

One of the many applications of electricity is that of giving shocks to the general public at 5 cents a shock. An outfit for the vending of such wares and its

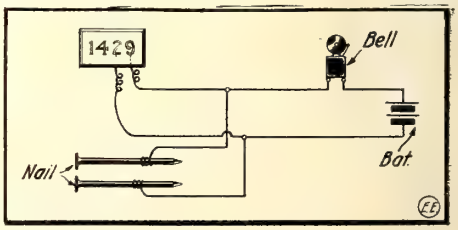


The Man Who Sells You Electricity at 5 Cents a Shock.

owner are seen in our illustration. This machine is familiar to those who live in New Orleans, and similar outfits are scattered throughout the country. A powerful-looking induction coil, appropriately trimmed up with polished brass balls and what-nots, serves to create a mysterious effect. A massive "current" gauge indicates how many "volts" are being taken through the handles shown.

SECRET CONTACT FOR CLUB BELLS.

When private clubs or houses desire a secret bell-ringing contact it is easily arranged for, as shown in our sketch. The two wires of the circuit are connected to any two metallic numbers on the house number, or the wires may be joined to two nails, et cetera. When the proper party comes along he simply short-circuits the nails or numbers connected to the bell circuit and the bell rings. Ordinary bell or annunciator wire No. 18 gauge is all right. A couple of dry cells and a 2½-inch gong bell complete the outfit. A knife or piece



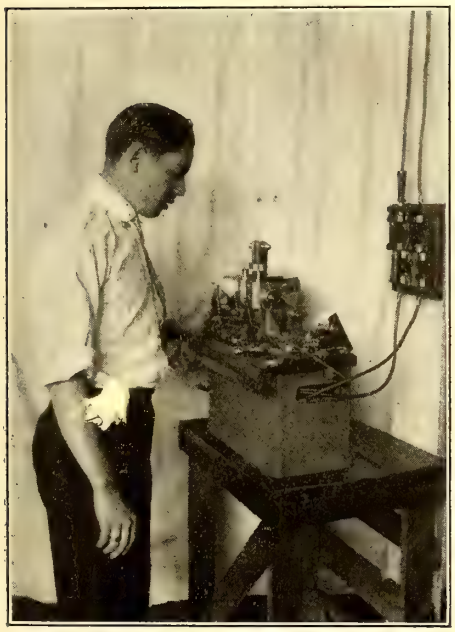
A Piece of Wire or Knife Blade Placed Across the Door Numbers, etc., Rings the Secret Club Bell.

of wire should be used to short the contact points on numbers.

RAPID ELECTRIC WELDING.

MACHINES of the butt welding type are now available for the manufacturer who has great quantities of one kind of work to weld electrically. They are not intended to replace the blacksmith where a variety of work is done, but on repeat work a boy with a welding machine can turn out more work than a dozen blacksmiths, and do it better, at a saving of anywhere from 60 to 90 per cent. in labor cost in many cases. Two pieces of metal are placed in the jaws of the welder, with their ends touching each other. The electric current is turned on and they instantly begin to heat. The boy operating the welder can see when the metal is white hot and begins to soften. He pulls a lever and forces the ends of the stock into each other. The metal is in full view of the operator at all times, instead of being concealed in the coal and flames of the "smithy's" forge. No smoked glasses or goggles are needed, any more than they are by the blacksmith. There is no scarfing to be done and, due to the way the metal is forced together, there is no oxidization, consequently no welding compound is required or used. The machine here shown is one of the Toledo Electric Welder Co.'s small machines.

This is not the case with fire welds, as the formation of scale due to oxidization, and the difficulty of applying the heat uniformly and welding quickly enough after taking from the forge, prevents the ideal conditions under which electric welds are made.

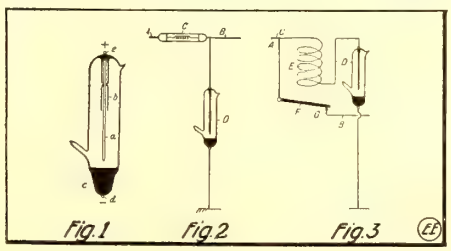


A Boy, with the Modern Electric Welder, Can Turn Out Remarkable Work in Quantity.

VACUUM TUBES FOR TELEPHONE AND TELEGRAPH LINE PROTECTION.

A very useful application of the vacuum tube was recently perfected to be utilized in telephone and telegraph line protection. Fritz Schroeter in the *Electrical World* describes a new form of vacuum tube which is effective down to 130 volts.

The construction is shown in Fig. 1. The anode (a) is an aluminum pin surrounded by a protective tube (b). The lower end of the anode (a) is at a distance of a few millimeters from the cathode (c) which is a fused alloy of potassium or sodium. Current is supplied through platinum wires (d) and (e). The tube is filled with a rare gas such as helium, neon, argon or a mixture of these gases at a pressure of from 1 mm. to 3 mm.



This tube may be used with connections of either Fig. 2 or Fig. 3. In Fig. 3 the telephone transmission line (A) is separated from the exchange line (B) by a relay consisting of three parts, E, F and G. When a dangerous voltage occurs a brush discharge takes place in the vacuum tube D because the high resistance of E (of about 8,000 ohms to 15,000 ohms) prevents the currents reaching an intensity sufficiently high for the evaporation of the cathode, which would produce an arc. The current passing through E excites the relay and attracts the armature F so that the contact between lines A and B is broken.

THE WOOLWORTH TOWER IN NEW YORK.

The tower of the Woolworth Building, a remarkable photo of which is shown here, is a veritable flaming torch at night, illuminated by the thousands and thousands of electric lights. The gilded surfaces of the mansard roof from the fifty-third to the fifty-eighth stories are turned at night into a glow of light which is even more picturesque than by light of day. Six hundred projectors, each containing a 250-watt Bryan-Marsh Mazda lamp of the new gas-filled type with closely contracted filament, in addition to the 24 1,000-watt lamps in the lanterns, help to illuminate the upper portion of the building, which houses over 30,000 inhabitants. The total power consumed is 175 kilowatts The installation required 50,000 feet of conduit from ½ to 3 inches diameter; 500,000 feet of No. 14 duplex wire were used. The reflecting characteristics of the glazed terra-cotta surface of the building and the necessity for mounting the large amount of equipment in a few restricted locations of the tower itself caused unusual difficulties in the design of the lighting scheme and equipment and in the installation features.



Photo (C) by Underwood & Underwood.
Beautiful Appearance of the Woolworth Tower, New York, Illuminated at Night. City Hall Park in Foreground. "Nickels and Dimes Built It."

LIBERTY BELL HEARD ACROSS CONTINENT.

The historic old Libery Bell, at Independence Hall, Philadelphia, which tried so valiantly to proclaim, far and wide, the joyful news of our declaration of independence, recently tried its voice again, and this time succeeded in making itself heard a thousand times further. Fitted under the bell was a telephone transmitter from the trans-continental line (it may be seen just below and in front of the bell), and when it was tapped with the mallet the ring of the cracked old bell was heard in San Francisco. A record of this historic event was made by a phonograph, seen in the picture, so that the tones of the veteran of Revolutionary times might ring down through the ages.

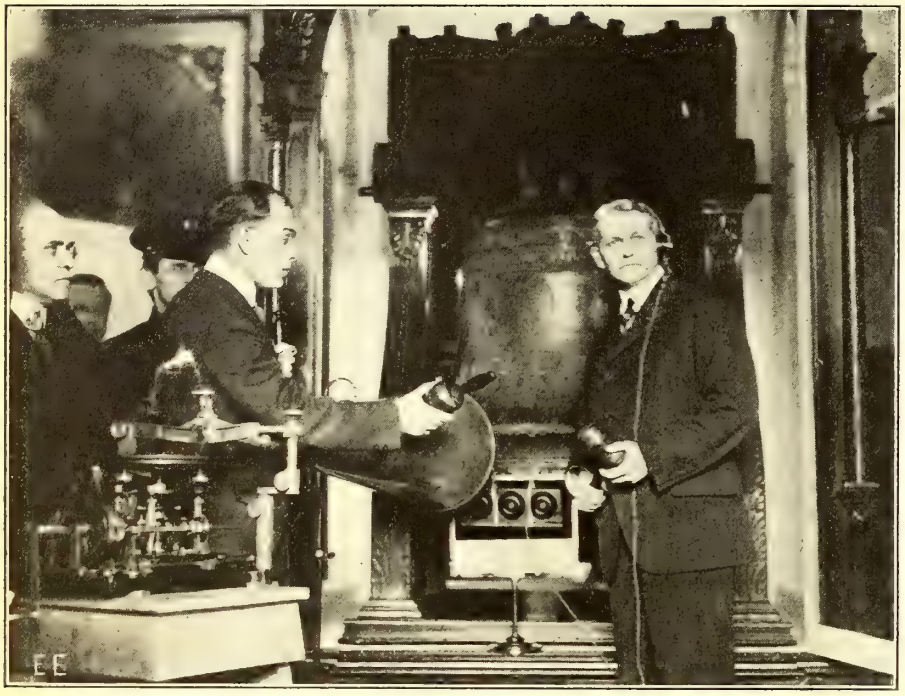


Photo (C) by Underwood & Underwood.

In the Recent Opening Tests of the Trans-Continental Telephone the Sound of the Liberty Bell Was Heard in Frisco. A Phonograph Also Recorded It.

ELECTRICITY IN NATURE.

(*Continued from page 5.*)

Why are lightning conductors attached to tall edifices, monuments, etc.?

Because they convey the electricity of the air and clouds *harmlessly* to the earth.

Why does copper form the best lightning conductors?

Because it has been found that electricity passes over a copper surface *more rapidly than over any other.*

Why do they convey electricity harmlessly to the earth?

Because electricity flies along their substance with great velocity; therefore it passes harmlessly away. It is only when its progress is *resisted* by a *non-conducting body* that electricity manifests *force.*

Do lightning conductors attract electricity?

They do not *attract electricity,* they merely afford it a *rapid conduction* when it happens to reach them. They no more attract electricity than water-pipes attached to a house attract water.

Why should a large building have several conductors?

Because elecricity may strike upon *any part* of a building. It is, therefore, proper to have several conductors, and to ramify their branches over the surface of the edifice, so as to form *a perfect system of conduction.* A ship having three masts, only one of which was protected, had her unprotected masts shattered, while the protected one remained untouched.

Why should the conductors terminate in earth?

Because then the electricity would be discharged from the conductors, and would have a *sufficient area of escape,* without creating a shock.

It is a good plan to attach the conductors to the gas-pipes in the earth, or to convey them to any body of water near the building.

BARON MÜNCHHAUSEN'S NEW SCIENTIFIC ADVENTURES.

(*Continued from page 3.*)

manner, luckily for me. Instead of which he uses a hollow needle and injects the embalming fluid into my veins. I am a sound sleeper. A very sound sleeper. Suffice it to say I did not wake up for a long time. As time goes, a rather very long time. To be accurate, I did not wake up for 110 years. It seems the embalming fluid that Rosskopf used on me was a good brand, for it did not wear out for 110 years, i. e., till A. D. 1907. It seems that this embalming fluid made my body rigid and stiff like stone, and to all intents and purposes, unknown to me, I was as dead as my wax replica, which they had buried the same afternoon. However, it seems my heart had continued to beat faintly through all these years and the prolonged rest, instead of aging my body, really made me younger. Although technically I am to-day almost 200 years old, I really feel like 30. You see what a good rest does! The next thing I knew was when I finally woke up and sneezed about 10 times. I was still on my bed in my secret room!

"You ask how it can be possible. Simplicity itself. Only Fritz and I knew of the secret room. Rosskopf, the embalmer, when he became sober again had promptly forgotten all about it, of course, so he really did not know any more than anyone else.

"As I found out afterward, this is what happened: Fritz, my trusted valet, had gone over to the burial vault to lock up the heavy oak door. But it seems that the door snapped shut while he was inside of the vault. As I lived alone with him, there was no one to release him but me, and he naturally thought I would miss him in time when I would, of course, release him. I did so—in time—110 years after! Poor fellow. I cried a bit when I saw his bones.

"But to go back. I said I woke up trying to sneeze my head off. For a few minutes I could not see anything for the dust I made while sneezing. I got up and felt rather stiff, and hungry as a bear. I opened the window and looked out. The strange sights I saw there fairly made me dizzy. It took me some hours to get used to it all; to make a long story short, it finally dawned on me that I must have slept for years. In the afternoon I cautiously walked down and inspected the house, which looked to me the same as on the day I went to sleep. I then ventured out in the neglected, unkempt garden, and after satisfying my hunger by means of a few dozen pears, I sat down on a decaying bench to think about the strange situation. While I was pondering about it I noticed a sheet of printed paper on the ground. It proved to be a part of a recent Hanoverian newspaper. I picked it up casually and tried to read the somewhat unfamiliar type. Suddenly I saw the date: September 29, 1907! It was then—for the first time in my life—that I fainted dead away; the shock was too great.

"But your time is limited, my dear boy, so I will make it short. Suffice it to say that after I came to I went over to the city hall and explained the whole affair to the Herr Bürgermeister—our mayor. I had no trouble of proving my identity, and the dear fellow overwhelmed me with kindness. He fêted and dined me and insisted that the town of Hanover should give a fitting celebration in my honor, but this, however, I declined modestly. In the course of the dinner he told me that, due to all good traditions of German official red tape, my house and estate were still in the process of liquidation, as I had neglected to leave a will. So I went and filed my will that very day and my lawyers assured me that, as I could prove my identity without doubt, I should be able to inherit my own estate within at least 25 years. They further assured me that I need have no misgivings as to my political offenses which I committed 110 years ago; they argued that these offenses had been outlawed. That took a big load off my mind. Well, I guess we've chatted long enough for to-day, besides my power is getting low. . . ."

"But, Your Excellency," I shouted back into my transmitter breathlessly, "won't you please explain how you come to be on such an outlandish place as the moon, and if you are there, how can you exist, for there is certainly no atmosphere on the moon and the temperature is below zero. . . ."

"I would gladly tell you all this now, but it takes time to explain these things," it came back very weak and distant, "but as I said before, my power is getting low, so if you will be at your 'phones to-morrow night at 11 p. m., terrestrial time, I will gladly satisfy your curiosity. Good night!"

(The next story is entitled: **How Münchhausen Took Berlin with the Allies.**)

A wireless station often contains enough fine wire to reach the distance it signals over. No "right of way" expense occurs though, or pole line cost either.

The mighty 42-centimeter siege guns of the Germans are fired by electricity, as also the large howitzers.

A Small Rotary Converter and Synchronous Motor

AS many electrical experimenters have great difficulty in obtaining at small cost a low voltage direct current supply to charge storage batteries, operate spark coils, motors and other apparatus, they will find the following very efficient:

The shunt-wound direct-current dynamo of the 8 volt, 10 ampere type, used in conjunction with step-down A. C. transformer, and an adjustable rheostat will be found very superior for this purpose.

The alternating current voltage should be a little lower than that of the dynamo at 3,600 revolutions per minute. Higher frequencies than 60 cycles cannot be used very well. Lower frequencies require less speed.

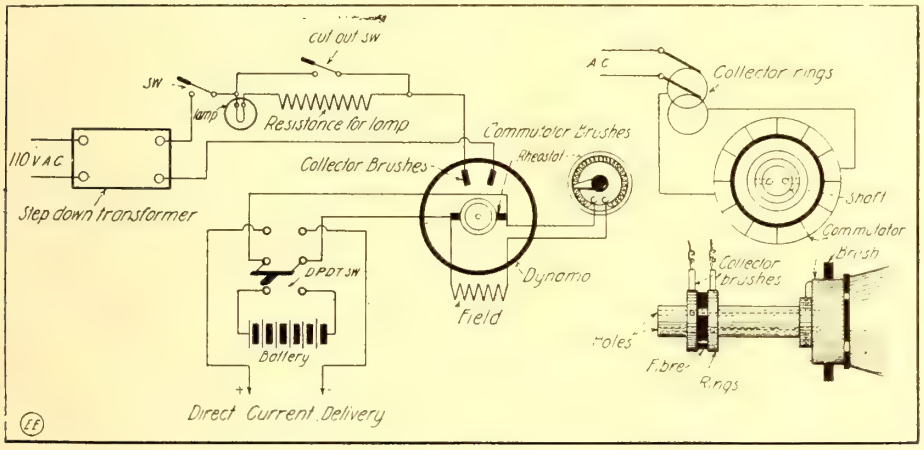
Two insulated collector rings of brass or copper are required on the shaft. A good place for these is between the commutator and the windings. They are connected to two opposite segments of the commutator (see drawing). Two brushes of springy copper or copper gauze, the holders of which are insulated from the frame with mica or fiber, are used in connection with the rings.

The dynamo should be brought to a speed of 3,600 revolutions per minute before connecting with the transformer. This may be done with dry batteries and varied with the rheostat in series with the field. When the desired speed is attained the switch which cuts in the synchronizing device may be thrown in. This device is a lamp of very low candlepower, equal to the voltage of both transformer and dynamo. If the candlepower is high the batteries may not be able to bring the motor to the desired speed, in which case a tungsten flashlight lamp with resistance in series is the best to use. Care must be taken to have sufficient resistance for the combined voltage of the transformer and dynamo to limit the current. The lamp should light up bright and go out, alternately, and while the light is out the switch which short circuits the synchronizing device (see drawing) may be thrown in and the batteries taken off. Direct current may then be taken from the commutator brushes.

If batteries are not available a hand drive may be used. In some cases the lamp may burn dim and continue so when the batteries are not strong enough to overcome synchronous speed. Then the short-circuit switch may be thrown in at any time and the batteries taken off.

This dynamo may be used to convert direct current to alternating current, the frequency varying with the speed, the direct-current supply being connected to the commutator brushes and the alternating current taken from the collector brushes and rings. This converter can also be used as an alternating current motor of unvariable speed, known as a synchronous motor, which is very desirable for driving rotary spark gaps in wireless stations, talking picture devices and many other purposes and applications.

Contributed by H. STEPHAN.



Simple Scheme for Making Any D. C. Dynamo a Synchronous A. C. Motor or Rotary Converter.

HAND-DRILL COIL WINDER.

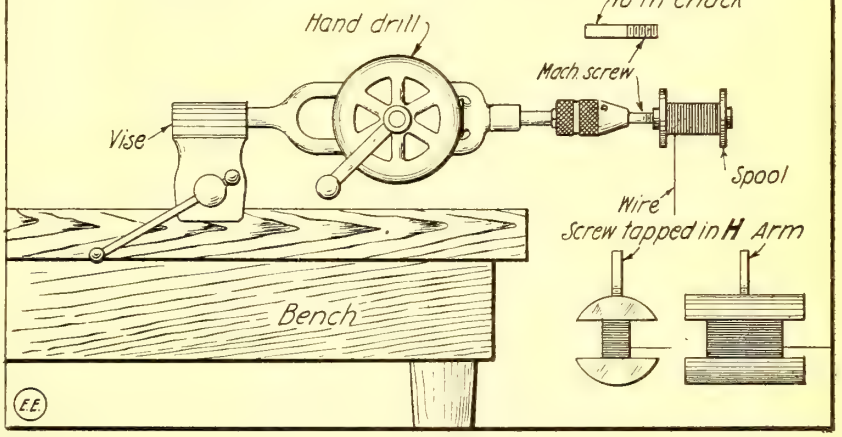
I made a very simple and durable winding machine from a hand-drill.

I clamped the hand-drill in the vise by the projection of the bearing of the large gear at the back of the drill; then clipping the head off of a machine screw that would fit the magnet I wished to wind. I then fastened it in the chuck, screwing the magnet core on this and proceeded to wind on the wire by turning the handle.

Afterward I wound the bell coils of a telephone and the "H" armature of a telephone generator in the same way. On the armature I had to thread one of the holes with a tap wrench and tap.

Submitted by

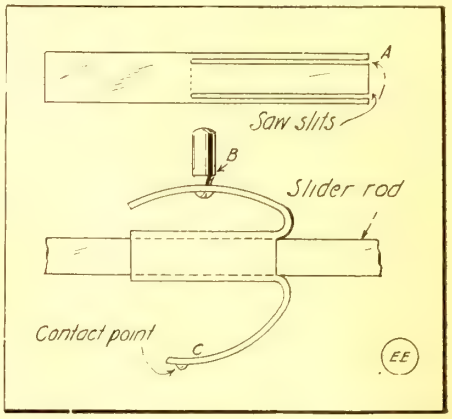
L. N. STUART.



Showing How to Wind Magnet Coils, Shuttle Armatures, etc., with Ordinary Hand Drill in Vise.

TUNING COIL SLIDERS.

I have had great trouble with sliders for tuning coils. I have had success with the style I am going to describe. The greatest trouble is making the contact strip and fastening a handle. To make one proceed as follows:



Simple Rheostat or Tuning Coil Slider Made from Piece of Square Brass Tube.

Get a piece of square brass tubing about 3 inches long and large enough to slip over the rod easily With a hack saw slit it down 1½ inches (at A); then bend back and cut the remaining part out. Now drill a 11-64-inch hole (at B). Next, with a center punch, make a small dent (at C). An ⅛-inch 8-32 screw passes through the upper limb as a fastening for the handle.

Submitted by EDWARD MINNIS.

RADIO-CRYSTAL SENSITIVITY.

B. Hoyle referred to experiments carried out in order to ascertain the effect of frequency on crystal sensitiveness in a recent talk at Liverpool, Eng. Carborundum, which was known as a definite rectifier of oscillations, and perikon and radiocite, which were thermal in action, had been investigated and found to be very constant over a range of frequencies varying from 100,000 to 1,500,000 per second. Regarding the thermal action on low oscillating currents changing to valve action for large currents, experiments carried out by the speaker had shown that up to 12 or 14 microamperes the ratio of current in one direction to current in the other was unity, but above this value the ratio gradually increased to three or four to one.

The telegraphone records telephone speech by magnetizing a moving iron wire.

WRINKLES—RECIPES—FORMULAS

Edited by S. GERNSBACK

Under this heading we will publish every month useful information in Mechanics, Electricity and Chemistry. We shall be pleased, of course, to have our readers send us any recipes, formulas, wrinkles, new ideas, etc., useful to the experimenter, which will be duly paid for, upon publication, if acceptable.

FORMULA No. 9.
Cements for Work Shop.

Leather Belting Cement.—Take 1 part of *Common Glue;* 1 part of *American Isinglass.* Place them in a boiler and add water sufficient to just cover the whole. Let it soak 10 hours, then bring to a boiling heat and add pure *Tannin* until the whole becomes ropy or appears like the white of egg. Apply it warm. Buff the grain off the leather where it is to be cemented, rub the joint surfaces together; let it dry for a few hours, and it is ready for use. It will not need riveting, as the cement is nearly of the same nature as the leather itself.

Cementing Brass to Glass.—16 parts of *Copal Varnish;* 5 parts *Drying Oil;* 3 parts *Turpentine;* 3 parts *Oil of Turpentine;* 5 parts *Liquid Glue;* 10 parts *Stucco.*

Cement for Glass and Porcelain.—1 part of *Casein;* 6 parts of *Sodium Silicate.* Dissolve; apply at once and dry in the air.

Chemical Cement.—Mix together 5 lb. of *Resin;* 1 lb. of *Wax;* 1 lb. of *Red Ocher;* 2 oz. of *Plaster of Paris.* Melt the whole with moderate heat.

Cutler's Cement.—4 parts of *Resin;* 1 part of *Beeswax;* 1 part of *Plaster of Paris.*

Electrical Cement.—5 oz. of *Resin;* 1 oz. of *Beeswax;* 1 oz. of *Red Ocher.* Dry the ocher on a stove. Melt the wax and resin together and stir in the powder till cold. Best cement to fasten brass on glass tubes, etc.

Iron Cement.—7 lb. of *Iron Borings;* 2 oz. of *Sal Ammoniac;* 1 oz. of *Sulphur; Water* in sufficient quantity.

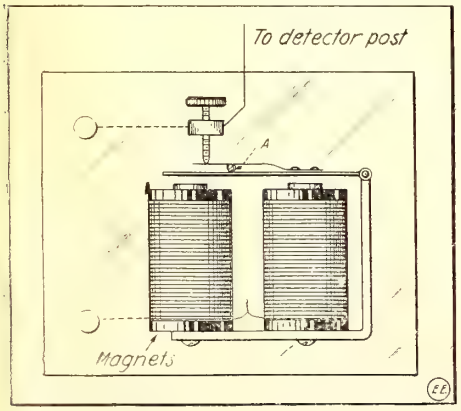
Stone Cement.—25 parts of *Linseed Oil;* boil with 35 parts of *Litharge* and 250 parts of fine powdered *Burned Lime.* Use hot.

Waterproof Cement.—1 part of *Glue;* 1 part *Black Rosin;* ¼ part *Red Ocher.* Mixed with least possible quantity of *Water.*

Cement for Wood.—Melt in an iron pan 1 oz. of *Resin;* 1 oz. of pure *Yellow Wax,* and stir in 1 oz. of *Venetian Red.* Use while hot. When cold it is as hard as stone. S. G.

MAKING THE BUZZER HY-TONED.

Some amateurs may be troubled by the harsh tone of the buzzer test. I remedied



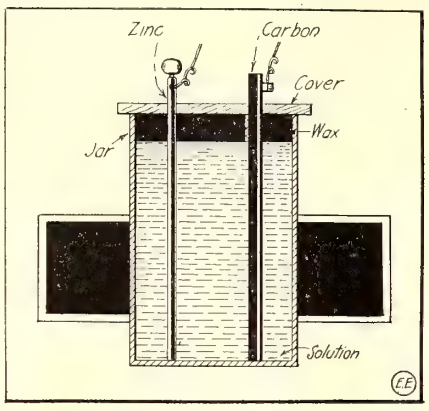
A Piece of Match "A" Between Armature and Spring Gives Hy-note.

this trouble in a simple manner, and the buzzer now sounds as good as the navy type. Secure a piece of match stick (a) about ⅜-inch long and pry it between the little piece of metal that is fastened on to the vibrator proper and the vibrator. It will be found that the note of the buzzer is increased in this way considerably.

Contributed by
ALEXANDER BOLLERER.

A SIMPLE BICHROMATE CELL.

A very simple bichromate cell can be made as follows: Place an ordinary car-

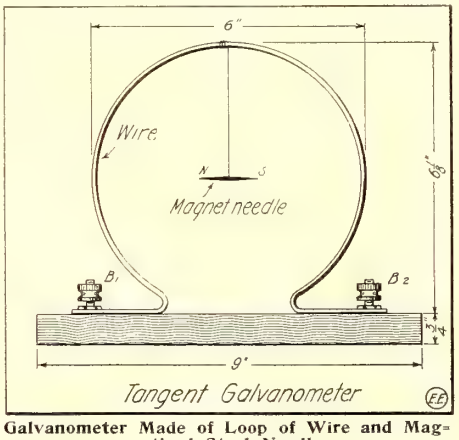


A Powerful Battery for Experimental Work.

bon rod and a circular zinc rod into a jar, as shown in illustration. The electrolyte consists of a mixture of one part of potassium bichromate to two parts of concentrated sulphuric acid, and the rest water. The cover and top of jar should be well coated with paraffin. Care should be taken to remove the zinc rod from the solution when the cell is not working. This cell is excellent for running motors and spark coils.

HOW TO MAKE A TANGENT GALVANOMETER.

Procure a wood base 3x6x¾ inch and on it drill two holes for the binding posts B1 and B2. Then take a piece of copper



Galvanometer Made of Loop of Wire and Magnetized Steel Needle.

wire or rod about ⅛ inch in diameter and nearly 22 inches long and bend it so as to make a circle 6 inches in diameter. Before doing this it is better to hammer the ends down flat, but do not drill the holes for the binding posts until you know where they come to. Next set this up on the base with the binding screws, which act both for connection of the electric current and support.

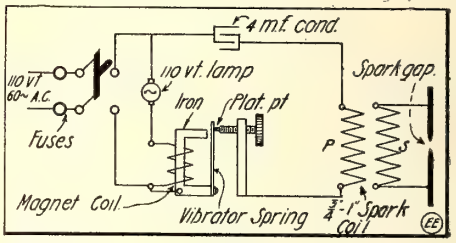
Next magnetize a steel sewing needle and tie a piece of fine thread (preferably a fine strand of silk) to the center of it and tie the other end on the top of the circle so as to let the needle hang in the center.

The coil can be made of several turns of No. 18 D. C. C. bell wire, etc., and the magnetic effect on the needle will then be greatly multiplied.

Contributed by CHAS. ANSLEM.

UNIQUE A. C. OPERATION OF SPARK COILS.

A very novel arrangement for operating ¾ to 1-inch spark coils directly from 110-volt 60-cycle A. C. circuit which has been used considerably in practise is shown in the accompanying diagram. As will be seen, a vibrator is utilized, which has a laminated sheet-iron frame, U shaped with a thin piece of clock spring as an armature, secured to the longer leg of same. A coil of wire is wound on the central leg of the iron core, and the alternating current, passing through this coil and a 110-volt lamp, sets up a rapidly fluctuating or alternating magnetic force in the iron. This force, acting on the vibrator spring, manages to interrupt the contacts regularly, the same as any other vibrator used on spark coils. One of the most novel features of this arrangement lies in the fact that the spark coil primary P is connected in series with a 4 M. F. tinfoil and waxed paper condenser, such as used in telephone work, as indicated. The coil thus derives just sufficient



Efficient Way to Operate Spark Coil on A. C.

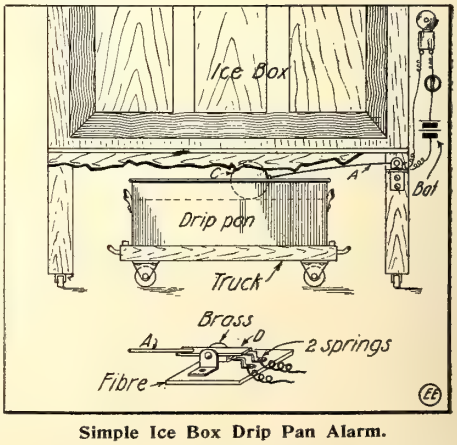
current through this condenser, which is of considerable capacity, viz., 4 M. F.

A DRIP PAN ALARM FOR ICE CHESTS.

I wish to make a contribution to your magazine in the form of a "Drip Pan Alarm," which I believe will be in demand in nearly every home.

Its construction is very simple and the illustration makes it all very plain. All that is needed is an electric bell, wire, batteries, an empty condensed milk can and a slender stick or brass rod about ⅛ inch diameter. The bell is fastened on the side of the ice box and connected with the batteries as shown.

The milk can C is sealed up to act as a float at the end of rod A. The other end of A is threaded in a swivel piece D. This in moving downward makes contact across the two brass springs shown, which are mounted on the fibre base plate. Two brass "L" pieces serve as trunnions for the shaft pin of D-A.



Simple Ice Box Drip Pan Alarm.

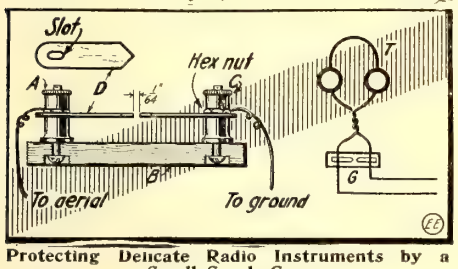
As the drip pan gets full of water the float C rises and eventually closes the bell circuit through the springs.

Contributed by
WILLIAM WARNECKE, Jr.

RADIO RECEIVER PROTECTIVE GAP.

A very simple method of protecting wireless receiving sets and also the expensive and delicate telephone receivers is indicated by the small spark gap shown in the sketch.

This gap is made up simply from a couple of pieces of ⅛x⅜-inch sheet brass, etc., having the two abutting ends pointed. A couple of binding posts of telegraph pattern are mounted on a base B to support the two spark gap electrodes D. The gap is made very short when same is set, or about 1-64 to 1-100 inch. It is common in a great many stations, including commercial and other stations, to connect one of these gaps across the aerial and ground leads where they join the instruments



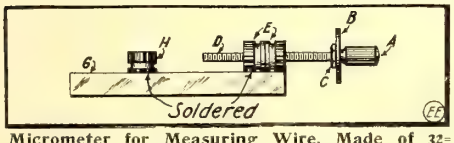
Protecting Delicate Radio Instruments by a Small Spark Gap.

proper, and also it is very advisable to place one of these gaps across the telephone receiver cord terminals as shown in the diagram, T being the telephones and G the protective gap. Any heavy static discharges coming down the aerial will thus jump these gaps and proceed to earth without affecting the instruments at all. Such static discharges will take the shortest path via the gap in preference to the high impedance circuit through the 'phone windings.

A CHEAP MICROMETER.

The drawing shows how to construct a micrometer which gives fairly accurate results, and it is handy to measure thickness of glass for condensers, etc. At G is a piece of ¼-inch-square brass rod. At E are two brass thumb nuts from an old, dry cell, soldered to G. C is a hexagon nut, tapped 8-32. H is a brass thumb nut from dry battery and soldered to G, called the anvil. The screw D is taken from a dry cell and should have 32 threads to the inch. B is a washer and should have four notches filed in the edge. By unscrewing the screw one full turn from the anvil H you get 1-32 inch; one-half turn, 1-64 inch, or two full turns, 1-16 inch, etc. A is an electrose knob.

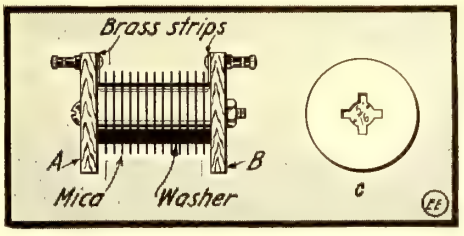
Contributed by DONALD HARDING.



Micrometer for Measuring Wire, Made of 32-Pitch Screw and Nuts.

A QUENCHED GAP FOR SPARK COILS.

The following is a description of a quenched gap which I have used successfully on my 1½-inch coil. The main idea may be obtained from the sketch. The end pieces, A and B, are of ¼-inch fiber, 1½ inches square. A 3/16-inch hole is bored through the center of each and another on corresponding corners. A 1½-inch bolt passes through the center holes and is taped on the inside to such a diameter that a washer having a 5/16-inch bore will fit closely on it. The length of the thread will depend on the number of plates used in the gap. Six or eight pieces of mica are then cut to the shape shown at C. Binding posts are placed in the corner holes and connected to the end plates with brass or copper strip. The mica rings and washers are then placed alternately upon



Simply Made Quenched Spark Gap.

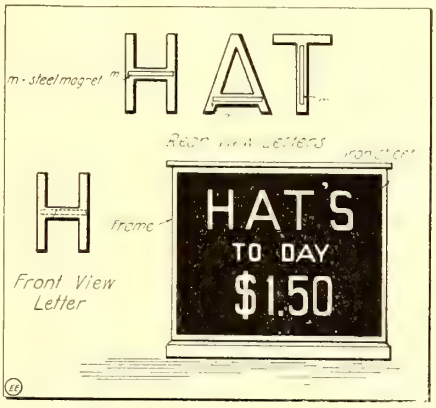
the mica or oiled linen tape and the whole fastened together securely by means of the center bolt. The spark obtained with such a gap, although not of high frequency, is musical and produces a pleasant note in the phones.

Contributed by J. W. HALLIGAN.

MAGNETIC LETTERS FOR WINDOW PLACARDS.

For rapidly and efficiently making up show-window signs or placards the latest conceit is magnetic letters, as shown in this illustration.

Expert window trimmers say that no show window is complete without a placard. But in windows in which the displays are changed often the expense for painting window placards is generally a considerable item in the advertising account. In fact, some electric companies pay from $3 to $7 a week for the painting



Window Placard Letters with Magnets on Them Enable One to Quickly Make Any Sign Desired.

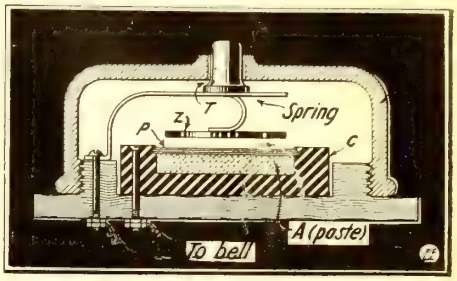
of cards with catchy phrases, which they claim supply a finishing touch to their displays. The letters used with these magnetic signs consist of metal patterns faced with heavy baked white enamel. To the back of each letter is attached a small permanent steel bar magnet about ¾ inch long. The backgrounds for these letters are made of iron of such thickness that it can be handled easily and can, to enhance its appearance, be placed in picture frames of narrow but neat design. When a placard for a window is wanted it can be made at a moment's notice with this outfit by placing the letters in any desired position against the black iron background, the small bar magnet holding the letters in place. With this system the placard wording can be changed as often as is desired without additional expense. Any form of wording layouts is thus available to the window decorator. No current is used by the device, so the only expense is the initial cost.

Electricity now pulls the boats through the Panama Canal.

MAKING A PUSH BUTTON BATTERY.

What would you think if you saw an ordinary-looking push button connected to a bell with two wires, no battery in the circuit, and upon the button being pressed the bell operated vigorously? The answer lies in the combined push and battery button illustrated in the diagram. Instead of two simple brass springs in the button cover there is a circular carbon block C, together with some blotting paper P and a small circular piece of zinc sheet Z. The button T presses down Z against the treated paper P, paste A and carbon C, thus forming a battery.

The blotting paper is first treated or saturated with a solution made of equal parts



A Push Button that Rings a Bell without Any External Battery.

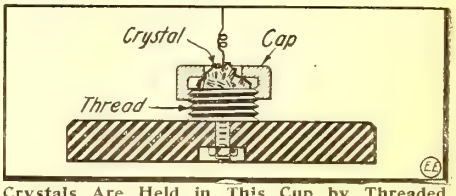
of chloride of zinc and cooking salt. The paper is cut slightly bigger than the opening in the carbon block, so as to be held in place properly. In the circular recess under the blotting paper is placed a stiff paste made up as follows:

Two parts pulverized asbestos; 10 parts mercuric ammonium chloride; 3 parts cooking salt and ¼ part of chloride silver. Melt all parts together, and after they have cooled sufficiently they are pulverized. Then mix up a stiff paste by adding slowly chloride zinc and water. Fill the carbon recess A full of this paste. The zinc plate Z should be about 1¼ inches or larger in diameter, and the carbon in proportion.

This battery push button is capable of giving 1.6 volts, and will last four or five weeks or more on one charge of prepared blotting paper. This considers that the casing fits tightly to keep the battery chamber practically air-tight. Such a device is useful in many ways besides its "magic" effect on the uninitiated, who will hardly suspect that such a small device contains a battery.

A SOLDERLESS DETECTOR CUP.

This detector cup has been designed for the purpose of eliminating the use of a low temperature alloy and to enable a



Crystals Are Held in This Cup by Threaded Compression Cap.

quick change of crystals without changing the cup. There are two parts—the base on which the crystal stands and the shell which covers the crystal. The base is a circular piece of metal one inch in diameter and threaded on the side all the way around. There is a threaded shank on the bottom by which the cup is held to the detector base. The second part of the cup is a brass shell or cap to fit over the base and screw down on the mineral. It is threaded on the inside to fit the threads on the base. There are corrugations around the side of the shell or knurl to give a better grip.

Submitted by GODFREY RIGBY.

WIRELESS DEPARTMENT

Wireless Telephony and Telegraphy on Union Pacific Railroad

By Frank C. Perkins

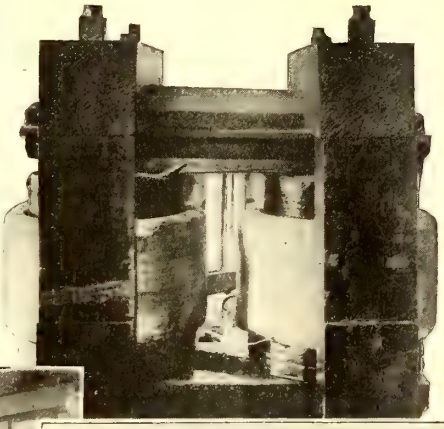
THE accompanying illustrations show the electrical laboratory and railway equipment for work on wireless telegraphy and telephone service, which has taken place on the Union Pacific at its shops and headquarters, through the efforts of Dr. F. H. Millener, the wireless experimental engineer of that railway system.

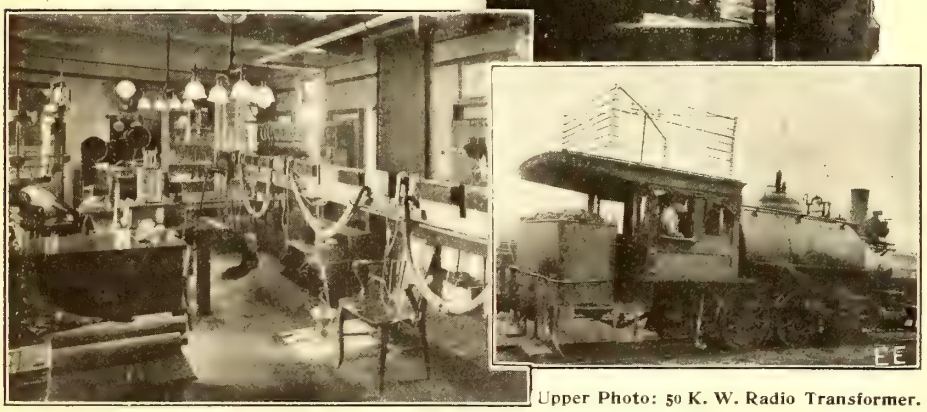
Dr. Millener has made some interesting experiments on the Union Pacific Railroad in the line of communication between trains, and between stations and trains, by wireless telegraph, wireless telephone, and by wire. He points out that "the commodity most in demand in the world to-day, and that which the world will pay the highest for, is speed. The second is safety, as safety lowers the price to be paid for speed, and any instrument or thing which will add to these two great commodities must have a value to mankind." The elevation at Omaha is 1,200 feet, gradually rising until an elevation of 8,000 feet is reached at the summit of Sherman Hill, Wyoming. In planning for wireless telegraph stations this elevation has to be taken into considertion.

It is pointed out by Dr. Millener that another thing which enters very closely into the consideration of the subject is static electricity. In summer the static electricity between Green River, and Cheyenne, Wyo., and Sherman Hill, Wyo., causes all sorts of disturbances with block signals, burning them out, and occasionally putting the wire telegraph out of commission. Therefore, as a result of experiment, it was decided that the induction coil method of generating wireless impulses, or waves of the 60-cycle, alternating current variety, would not be satisfactory; for, even if nine messages out of ten were received properly and the tenth not so, fate would in all probability make that message the most important one.

It is stated that various schemes were tried, but it was found that the best results could only be secured by using a higher frequency than 60 cycles. Therefore, for the stations at North Platte, Neb., and Green River and Cheyenne, Wyo., it was planned to use a frequency of about 550 cycles transformed up to about 12,000 volts in an open core transformer, with a 5 kw. generator at Cheyenne, a 5 kw. at North Platte, and a 10 kw. at Green River.

The station at Cheyenne is to work at all times, day or night, at least as far East as Omaha, and we hope an equal distance the other side of the mountains. The four stations—Omaha, North Platte, Cheyenne, and Green River—will thus work together at all times, and in all conditions of weather. In the telephone receiving the message from a high cycle, high frequency station, it is a high pitched note, similar in character to the sound of a tuning fork at 1,020 vibrations per second and is much pleasanter to listen to than the old 60-cycle low note. The sound also being high in pitch is not confused with static electricity; thus one of the greatest difficulties of the earlier wireless investigators is done away with.





Upper Photo: 50 K. W. Radio Transformer.

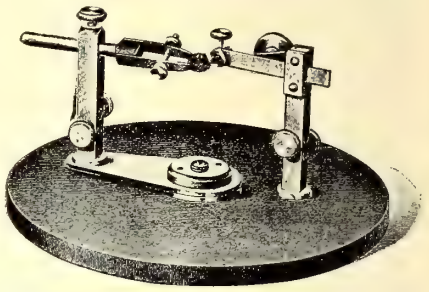
Left-hand Photo Shows Union Pacific R. R. Wireless Laboratory. To the Right Dr. Millener's Aerial Scheme for Locomotives.

As to aerials, or antennæ, it is said that in railroad work it is absolutely necessary to have the antennæ close and compact. In the first installation of the wireless telegraph station it is important not to complicate matters and to make the antennæ simple and easy to repair.

It is urged by Dr. Millener that the present tendency is toward using complicated apparatus and that this is not necessary; the simpler the better. It had been found that the use of the flat-top ships' antennæ is more practical than the umbrella type at stations, and parallel to the track, elevated by two self-sustaining towers, the height of which should be at least 210 feet and should be constructed to stand a wind stress of 90 miles per hour, at least, as we are building the wireless to work, when the wires go down.

A NOVEL DETECTOR STAND.

In the illustration here given is shown a novel radio detector stand, suitable for most any crystals, such as carborundum, galena, and silicon. It has a rotative arm,



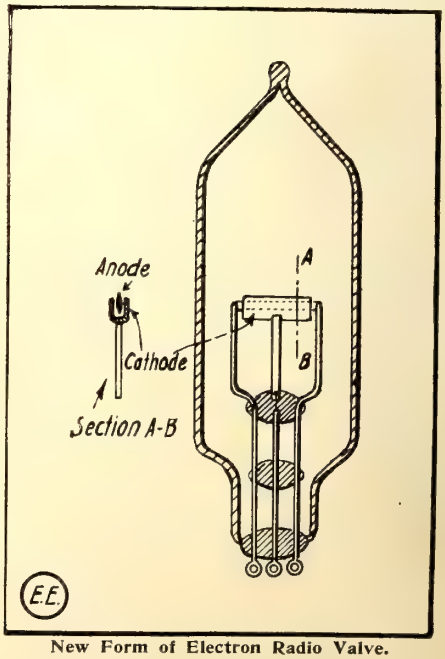
Carborundum Detector with Clamp Mounted on Rotatable Arm.

pivoted at the center of the base, which arm carries at its outer extremity an upright. This supports a sliding rod, having at its end a "drawing pen" type of crystal clamp.

A graphite or metal point is fitted adjustably on the other upright arm. Hence, most any adjustment desired can be obtained with this simple, yet ingenious, device.

A NEW WIRELESS VALVE.

The action of the kathodic detector or valve is based upon the peculiarity of hot, glowing bodies to send out negative emissions, which make it possible to ionize the space between the two electrodes of the detector. This makes it possible to use the valve as a wireless detector, for the reason that the received alternating currents and other very weak electromotive forces will be changed into uni-directional currents. The more powerful the emissions are, the more sensitive such a valve will be. The new Holweck valve recently invented has a kathode or a single metal piece whose sur-



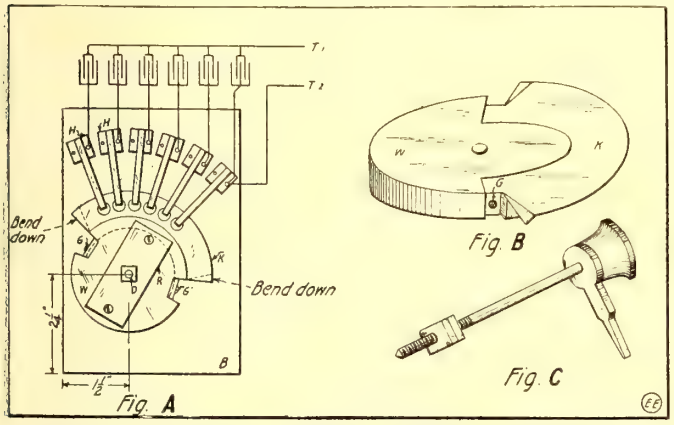
New Form of Electron Radio Valve.

face is ten times as great as those that have been used heretofore in the audion type valve. Furthermore, this surface is covered with a certain oxide which has been found as being quite necessary for the action. The distance between the anode and kathode is reduced to 0.1 millimeter; on account of this very small distance between the anode and kathode, one obtains a very strong and sure action. It is, furthermore, not necessary to take any of the ordinary cautionary measures during the operation of the valve. The temperature of the kathode must be capable of being regulated, and the anode is placed in series with an electromotive force the same as in other valves.

This new valve has been used with great success at the Paris Eiffel Tower and at the Arlington station.

VARIABLE CONDENSER SWITCH.

It is invariably the lack of adjustable condenser capacity that causes the harmful sputtering and sticking at the vibrator contacts of spark coils, run on a fairly heavy current. Furthermore, the stumbling block in making a variable condenser is the switch. The following is a description of an efficient variable switch that is easily made.



Condenser Switch, Acting by Moving a Metal Disc Successively Under Metal Strips.

The materials needed are usually lying about any experimenter's workshop. Procure a piece of sheet-copper or brass about 6x3 inches; half dozen brass-headed tacks; an old watch spring, about ⅛" wide; a piece of ⅜" board, 4x6 inch; an oblong piece of 1/16" brass, 1x2¼"; and an ordinary spool from magnet wire.

Fig. "A" shows the bottom view of the switch, with condenser connections for six variations. Figs. "B" and "C" show the three parts of the switch detached.

"B" is the base, showing the six-clamp contacts at H—H. To make this part, take the piece of ⅜" board, 6x4 inches, and drill in it a 3/16" hole for "D", Fig. "A" 1½" from one side and 2¼" from one end. From center of "O", with radius 3¼", describe an arc. This will form the outer boundary of the springs at H—H.

To make the clamp contacts, first break off six 1¾" pieces from the watch-spring. Cut 6½" squares from the copper plate, and, with large shears, clip off the heads of six brass-headed tacks. On one end of each piece of spring solder one of the copper squares; on the other end, a brass tackhead. Of course, the soldering is done on the concave side of the head. A good plan is to clamp the springs down, tack heads and copper squares in position, and to drop solder on each end. When the soldering is finished, plunge the springs into cold water to retain the temper of the steel. Screw these clamp contacts down as shown.

Fig. "A" shows the upper side. To get the wooden wheel for this part, saw off one end, "W", of the spool. Nearly opposite each other (about 160 degrees apart), cut two grooves, G and G', on this wheel. From the sheet copper, cut a circular blade, "K," ⅞" wide and 160 degrees long. The radius for the outside circle for this is 1⅞"; of the inside, 1". Cut a slit ½" deep, ½" from each end of the blade; bend the copper around and screw to the wheel as shown at G and G' in Figs. "A" and "B". On the upper side of "W" screw the rectangular piece of brass, 1x1⅞"; tap it to receive an 8-32 machine screw. Bend one edge of the blade at G down so the disc will not balk on starting past any switch contacts.

"C" is the turning rod, an 8-32 machine screw furnished with an insulated knob, indicator, and check-nut. Its length depends upon the thickness of the coil base.

It now remains but to assemble the parts. Drill a 3/16" hole through the base of the spark coil to receive screw "D." Push "K" under the springs as shown in Fig. "A." Screw all parts shown in "A" to the under side of the base of the coil, screw "D" down through "R"; screw on and tighten the check-nut. When the knob "D" is turned, six variations in capacity are secured. More can be had by adding additional spring contacts.

Contributed by
MAX EPSTEIN.

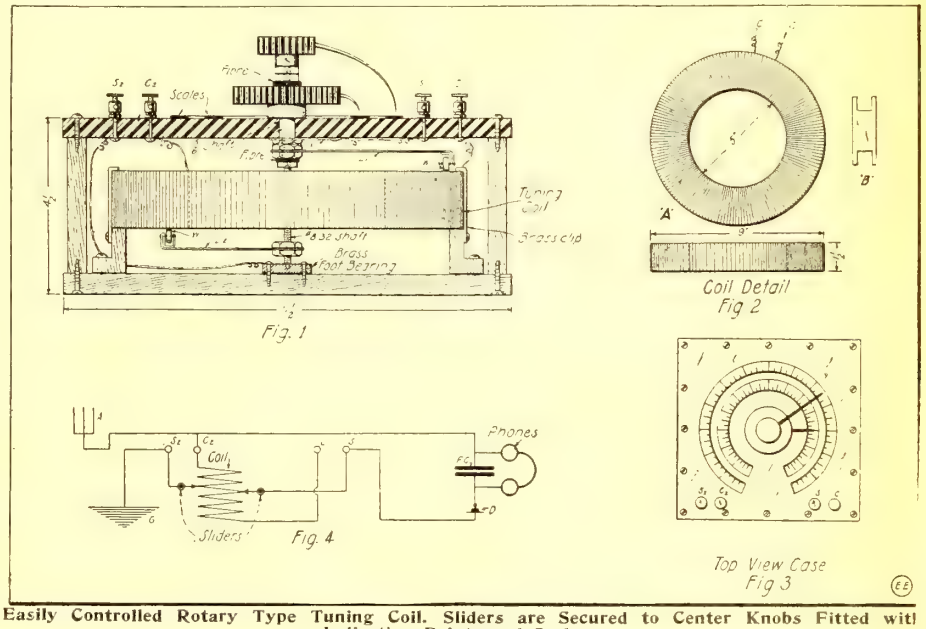
A ROTARY SWITCH TUNING COIL.

Those radio operators who believe in tuning coils will find the one described in the accompanying illustration of considerable interest, as the switch control is rotary in character, instead of the more crude "arm's length type," with sliders on bars. This design, here offered, is very efficient, both mechanically and electrically, and to give greater wave length range it may be made larger than here shown. The coil proper is made up on a wooden ring cut out by a fret saw from white pine, or other wood, to the dimensions given in Fig. 2. It should be sandpapered smooth, and the corners rounded. A coat of rather thickish shellac is given it; and, while yet slightly sticky, it is wound with one layer of No. 24 S. C. C. magnet wire.

The winding is done by first placing the wire on a small bobbin or stick, cut as at Fig. 2, B. If all the wire is inconvenient to handle at one time, it may be wound on in several batches, being sure to solder all the joints between various sections where the wire is joined. The coil should be well shellacked or, better, baked out in the oven with Sterling varnish after it is dry. The paths for the rotating arm contact wheels W, W, on arms L_1 and L_2, are sandpapered or scraped on the top and bottom of the coil. This coil winding is good for about 1,500 meters with ordinary aerial. Variable condensers will, of course, boost this wave-length figure.

The other details are perceived from the diagrams; the operating principle of the switches being that the smaller lever (L_2) rod rotates inside of a complete fiber or hard-rubber sleeve, with end washers, placed in the center of the larger moving shaft, which is threaded, as indicated, to receive suitable check nuts. A piece of 1/32 inch or 1/64 inch brass strip "X" is placed on the under side of the top cover, so that contact is made with the larger rotating spindle, S_1. Contact with the smaller spindle attached to lever (L_1) is maintained through the brass foot bearing and wire, as shown.

The whole instrument is mounted in a well-finished, hardwood case, or as the maker may elect. A hard-rubber top makes a fine appearance, and it only need be about ¼ inch thick or less, if backed by a piece of ¼ inch or ⅜ inch wood. Suitable dials are arranged for the needles (see Fig. 3) or indicators to pass over, the scale divisions being in degrees, etc. The scale for the detector circuit slider should be marked "Det." and the ground scale marked accordingly "Ground." Test the assembled shaft with 110 volts and a lamp to see that they are thoroughly insulated from each other. Diagram for standard connection are given at Fig. 4.



Easily Controlled Rotary Type Tuning Coil. Sliders are Secured to Center Knobs Fitted with Indicating Points and Scales.

Wireless telephony has been successfull tried out on D., L. & W. railroad expres trains.

The D. C. Arc for Wireless Telegraphy and Telephony

(Continued)

SLIDE 10. De Forest's method (see Fig. 9) is almost identical with that of Poulsen, except that he employs alcohol vapor in place of hydrogen.

The Dubilier System.

This is another hydrogen arc system based on the same principles. Dubilier employs an air-cooled arc, and the connections are so arranged that the oscillations of both the primary and secondary circuits pass across the arc. The connections are very similar to those used by the Anglo-French Wireless Co.

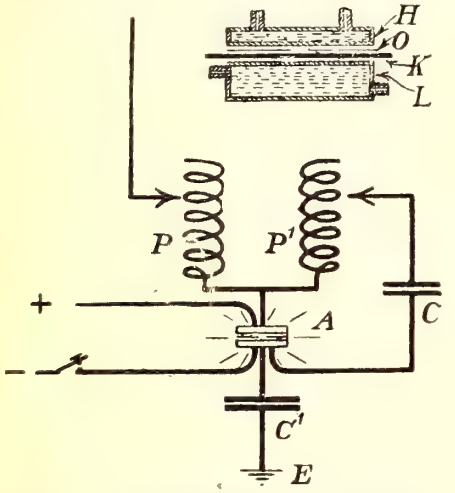


Fig. 12. The Lepel Quenched Arc High Frequency Generator.

Slide 11. We now come to a method of generating H. F. currents by means of a number of arcs in series in air (see diagram 10). This method is the outcome of the work of Duddell, Campos and Mosler. It has been thoroly developed by the German Wireless Telegraph Co. in Berlin. When a supply voltage of 220 volts D. C. is employed six arcs in series are required. On 440 volts twelve are necessary. The arcs are struck between water-cooled carbon anodes and carbon cathodes.

Fessenden.

We now come to the work of Fessenden. Those who have read the account of his lecture delivered to the American Institute of Electrical Engineers in 1908, will appreciate the enormous amount of work that he has done in connection with wireless telephony. In 1906 he constructed a H. F. alternator, suitable for wireless telephony. It was he who first used a microphone in the aerial circuit (see Fig. 11). In 1906, by the use of telephone relays of his own construction, he demonstrated the possibility of connecting a land telephone line to a wireless telephone station. I will read the following account from his lecture already referred to:

> "As it was realized that the use of the wireless telephone would be seriously curtailed unless it could be operated in conjunction with wire lines, telephone relays were invented, both for the receiving and transmitting ends, and were found to operate satisfactorily, speech being transmitted over a wire line to the station at Brant Rock, Mass., re-transmitted there wirelessly by a telephone relay, received wirelessly at Plymouth, Mass., and there relayed out again on another wire line."

These tests were witnessed on December 11th, 1906, by a number of scientific men, and reported in the American Telephone Journal. In 1907 Fessenden successfully transmitted speech between his wireless station at Brant Rock and a station in Jamaica, Long Island, a distance of about 200 miles. Fessenden has also invented a balance method of simultaneous transmission and reception.

For the balance method he uses a phantom aerial; this circuit having such capacity, inductance, and resistance as to balance the radiating antenna; also an interference preventer, one of Fessenden's inventions, one side of which is tuned to a wave length of the distant transmitting station. The drawback to this method is that half the energy is lost, and the conversation is only half as loud as it would otherwise be.

At diagram 12 is represented the Lepel system. In place of a hydrogen arc, there is a form of quenched arc. The instrument consists of a sheet of copper and a sheet of delta metal, (both of which are water-cooled), between which is a sheet of thin paper perforated with a small hole at its centre.

This apparatus can be operated by alternating current, in which case it acts as a quenched spark-gap; or it can be operated directly from a constant current supply, provided that the voltage is sufficiently high to form a self-striking arc between the copper and delta metal electrodes. It may be connected to an inductance and capacity in a similar manner to that employed for an ordinary spark-gap, but in practice it is connected as shown, so that both the primary and secondary circuit oscillations pass across it.

The Anglo-French Wireless Co. own and operate this system.

Fig. 13 shows the receiving connections used by the Anglo-French Wireless Co. There is nothing extraordinary about the connections themselves. I am showing this diagram because I think the extremely neat arrangement for the inductance may be of interest. T is the top of a table; a large circular hole is cut at its centre and an inductance is wound in a groove cut in the piece of the table that was removed. This is then pivoted across the circular hole in the table. Inductance 2 is wound in a groove in the table top. Inductance 3 is wound in the form of a flat spiral, and the board on which it is wound is hinged

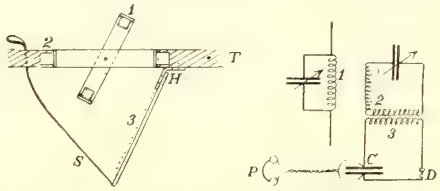


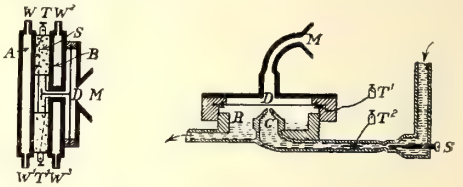
Fig. 13. Receiving Set Connections of the Anglo-French Wireless Co. Note Novel Coupler at Left.

to the underside of the table and can be pulled up and down from above by a strap S to alter the coupling. Inductance 1 is also turnable on its pivot, to alter the coupling.

The Morretti Arc.

There is another form of arc which I should mention, invented by Morretti. It consists of a copper tube supplied with water. An arc is struck between the water and a copper rod; it works on a high voltage direct current and the connections are the same as for a hydrogen arc. The oscillations are produced by a very rapid extinction and restriking of the arc, probably due to an action like that in a Wehnelt interrupter.

In conclusion, I should like to say a word or two as to the most suitable forms of microphones for wireless telephony, and just a word with regard to detectors and receiving apparatus. One of the greatest practical difficulties in wireless telephony has been to find a microphone capable of carrying a large current without becoming "packed" or overheated.



Fessenden's Carbon Grain Wireless Microphone.

Chambers' Liquid Microphone

Fig. 14. Two Types of Wireless Telephone Transmitters.

When dealing with a small amount of power, as I have been this evening, an ordinary "solid back" microphone answers quite well; but this is unsuitable for use with large currents. One way of getting over the difficulty is to connect a number of similar microphones in parallel, with all their mouthpieces connected to one trumpet. This method, however, is not thoroly practical, as the conductivity of each microphone varies from time to time and there is the likelihood of one or more of them overheating.

Fessenden in 1906 invented the first really practical carbon grain wireless microphone, which he claims will carry a current of 15 amps., without packing. The figure on the left-hand side of this slide (Fig. 14) shows the construction of the instrument. The carbon grains are held in a small chamber cut in the centre of a disc of soap-stone "S." Two platinum electrodes at the back and front of the chamber are water-cooled. A small rod passes through a hole in the front water-cooling tank and electrode, connecting the diaphragm D to a small spade or plunger in the centre of the grain chamber, which is only half filled with carbon grains by the way.

Dubilier uses a somewhat similar microphone.

The diagram on the right-hand side of this figure shows a Chambers' liquid microphone. This is another form of microphone. A small jet of acidulated water passes through a nozzle C and plays upon the underside of the diaphragm. When the diaphragm vibrates there is an alteration of resistance of the liquid at this point.

(To be concluded.)

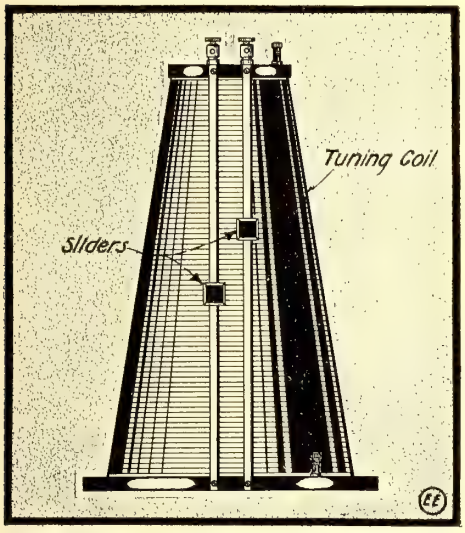
NORRISTOWN RADIO CLUB.

The amateur radio operators of Norristown, Pa., have organized and call themselves the Norristown Radio Club. The officers elected were: Earl Moore, president; Wilbur Heiser, vice-president; Charles Wolfe, secretary; Randolph Roland, treasurer, and Samuel Place, consulting engineer. The club would like to hear from such associations. Norristown Radio Club, Main street and Franklin avenue, Norristown, Pa.

RANDOLPH ROLAND,
Treasurer.

IMPROVED CONICAL TUNING COIL.

A decided improvement, which is not very well known, by the way, in the design and construction of tuning coils for use in wireless receiving sets is shown in the illustration. The improvement, in general, is based on the fact that with a tapered or conical coil it is possible to greatly increase



Conical Form of Tuning Coil, Equally Efficient on Long and Short Waves.

the flux density in the region of the lesser diameter turns on the coil when only a small inductance is used in picking up a certain signal coming in on a short wave length. When a longer wave length is being received, any part of the coil can, of course, be used. The idea, of course, to be followed is always to include as much as possible of the smaller end of the coil. It will be evident at once that when short wave lengths are being received much greater efficiency in the instrument will be the result when the turns of wire are small. This is the reason why extra large loose couplers and tuning coils are very inefficient on small wave lengths where only a few turns of wire can be used.

A common form of conical tuning coil is, as shown, provided with two sliders. The wood form on which to wind the wire may be turned in a lathe or can be made up at any cabinet maker's for a few cents.

It may be suggested that the conical form on which to wind the wire be made about 2½ inches diameter at the small end and 6 inches diameter at the larger end. It can be 11 to 12 inches long and wound with one layer of No. 24 enameled magnet wire. The wire, of course, is scraped or sandpapered free of insulation in the two paths where the sliders are to make contact. It is connected as usual in the radio receiving circuit.

TO FORM RADIO CLUB.

In December last members of the Y. M. C. A. branch at Asbury Park, N. J., interested in wireless telegraphy assembled for the purpose of organizing a wireless club. Jewell VanDyke and Harold Warren supervised the club. It is the purpose of Mr. Warren to teach the wireless code to the members, and there is no doubt but that within a short time the members will be able to receive messages nicely. During the past few weeks experiments carried on by Warren and VanDyke have in a large measure been successful, and messages are constantly being received. Mr. VanDyke is connected with the VanDyke Electric Company.

Novel Wireless Telephone Microphone

An ingenious wireless telephone microphone designed to carry several amperes, and which does not heat unduly or "pack," as ordinary carbon grain microphones tend to, is described by Mr. Scheidt-Boon in T. S. F. Our cuts of the instrument show clearly its novel means of handling heavy radiophone currents without over-heating.

Referring to the diagram we perceive at Fig. 1 a cross section view of the "continuously renewed" carbon grain microphone. Into the hopper (5) is placed a quantity of carbon grains which, of course, drop down and against the valve at 9. This valve (9) is mounted on a pivoted beam or lever (3), so that the two magnet coils (1, 1) can act on the iron armature secured to the end of the lever. The cup (10) catches the carbon grains as they fall through the opening (9).

The valve (9) may be arranged in different ways, as at Figs. 2 and 3, Fig. 2 being an angular valve and Fig. 3 a conical seat.

Now the action of the microphone will be readily understood from Fig. 4. Here an ordinary microphone (16) creates varying electric currents through the primary circuit (17, 18, 19, 20) of an induction coil. The secondary circuit (21, 22, 1) thus causes the magnets to exercise a varying magnetic pull on the lever (3), which is mounted on a circular metal diaphragm, and which vibrations correspond with the voice undulations occurring at (16). Hence the vibratory movement of the lever and valve (9) will cause a changing quantity of carbon grains (with consequent varying resistance) to pass through and between the two electrodes 23 and 24 (Fig. 4), which will thus vary and control the aerial oscillating current. The source of high frequency aerial current is not shown, but it may be a radio-frequency alternator or a Poulsen arc generator.

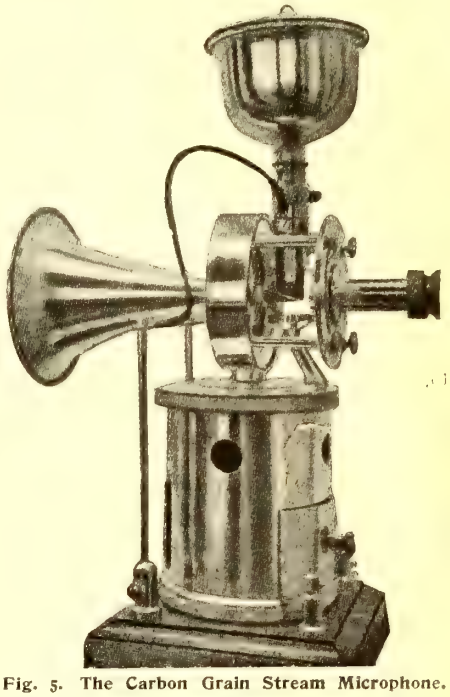
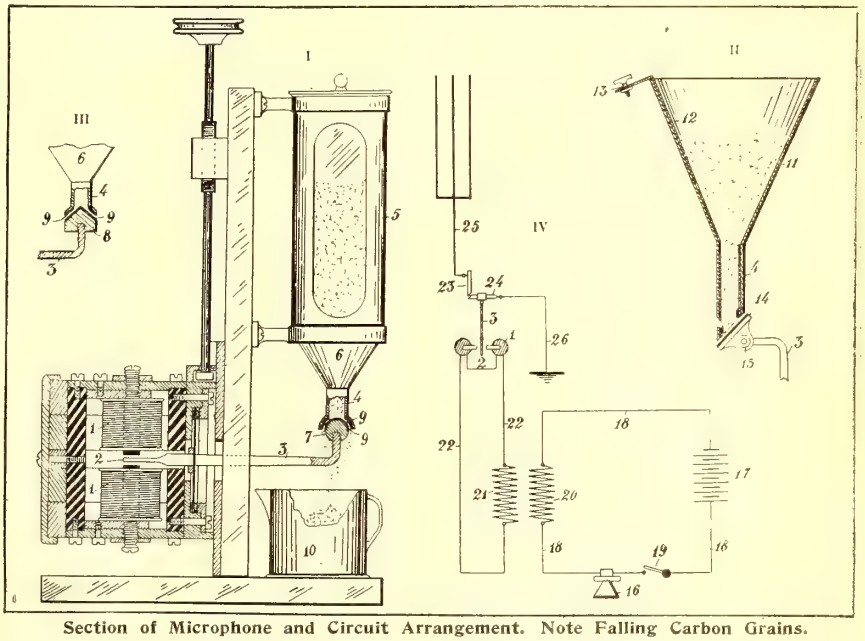


Fig. 5. The Carbon Grain Stream Microphone.



Section of Microphone and Circuit Arrangement. Note Falling Carbon Grains.

Fig. 5 is a photographic illustration of the device just described. The large horn to the left leads to the microphone, while the cup-shaped piece at the top contains the carbon grains.

YOUNG MARCONI RADIO CLUB.

The "Young Marconi Radio Club" met at the home of Albert St. Cyr, Jr., 319 Harrison St., Marquette, Mich., and an election of officers took place. The officers are as follows:

President and Secretary, Albert St. Cyr, Jr.; Vice-president, Herman Bittner; Treasurer, Edward Lundstrom; Chief Operator, Walter Frie; Assist. Operator, Will. Gasper.

We would like to correspond with other clubs.

ALBERT ST. CYR, Jr.,

COLLEGE RADIO CLUB NEWS.

At the last meeting of the Club, an election of officers for the ensuing year resulted as follows: Wm. C. Nolan, president; Earl S. Shader, vice-president; Phil W. Pelts, secretary, and O. C. Pavia, treasurer. Jack Forsythe is stenographer. Several new members were admitted and a plan for the year's work outlined.

PHILIP W. PELTS, Secretary, 612 Adams Avenue, Memphis, Tenn.

A round magnet coil contains the least resistance with a given core section.

HOW-TO-MAKE-IT DEPARTMENT

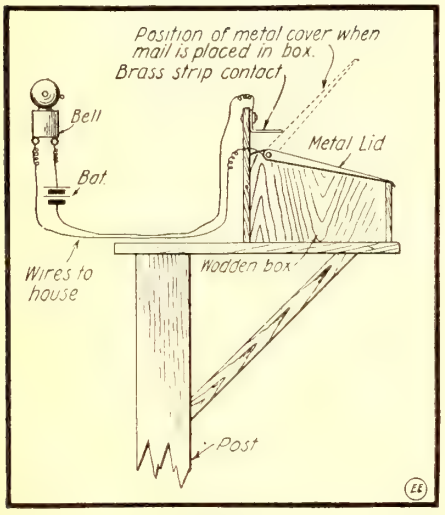
This department will award the following monthly prices: FIRST PRIZE $3.00; SECOND PRIZE $2.00; THIRD PRIZE, $1.00.
The idea of this department is to accomplish new things with old apparatus or old material, and for the most useful, practical and original idea submitted to the Editors of this department, a monthly series of prizes will be awarded. For the best ideas submitted a prize of $3.00 will be given; for the second best idea a $2.00 prize, and for the third best a prize of $1.00. The article need not be very elaborate, and rough sketches are sufficient. We will make the mechanical drawings.

FIRST PRIZE $3.00.

RURAL MAIL BOX ALARM.

I herewith give a suggestion which I am sure will meet the eye and taste of everyone living in a rural district where the mail is placed in a wooden box fastened on a post by the roadside. The purpose of my suggestion is to have an announcing bell at the house when the mail is placed in the box by the mail carrier and thus make a long wait unnecessary. The only article necessary is an electric bell which may be bought at any store for 25 cents. A roll of insulated bell wire must also be used. To furnish the current two or three dry cells are to be procured. Two cells will be sufficient for any distance up to 200 feet. Cut one thin brass strip, as shown in illustration, and also procure a metal lid to form a cover for the box. Both brass strip and metal cover are each put in connection with two copper wires strung to the house. The wires are simply tacked (by staples) on small posts driven in the ground, and the rest of the wiring, as shown in diagram, is very simple. The idea of this arrangement is as follows:

As soon as the mailman lifts the lid and places the mail in the box the metal lid comes in connection with the brass or metal strip and it causes the bell in the



First Prize: Rural Mail Box Electric Alarm Bell.

house to ring as a signal that the "mail has arrived." Submitted by

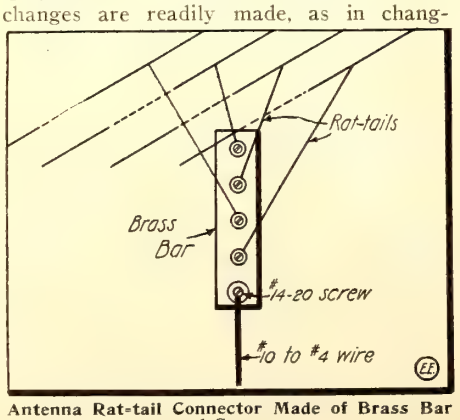
WILLIAM WARNECKE, JR.

SIMPLE ANTENNA CONNECTOR.

A very simple and efficient antenna rat-tail connector is illustrated below. This is made up from a piece of copper or brass bar about ½ by ¼ by 2½ inches. Four or more No. 8-32 machine screws are tapped into the bar, and these are furnished with washers under the heads, enabling the No. 14 wire rat-tails from the aerial flat-top to be clamped securely.

At the base, where the main lead-in wire or cable goes down to the instruments or lightning grounding switch, a heavier machine screw is fitted on the bar. This may be about No. 14-20 size machine screw.

If the lead-in wire is larger than No. 10 B. & S. conductor it is best to screw a lug under this screw and to sweat the large wire into the lug with solder. The rat-tails are usually tapered down to the connector for a distance of 10 to 20 feet. One feature of such connectors is that changes are readily made, as in changing from looped to straight-away system.



Antenna Rat-tail Connector Made of Brass Bar and Screws.

SECOND PRIZE $2.00.

UNIVERSAL CRYSTAL DETECTOR.

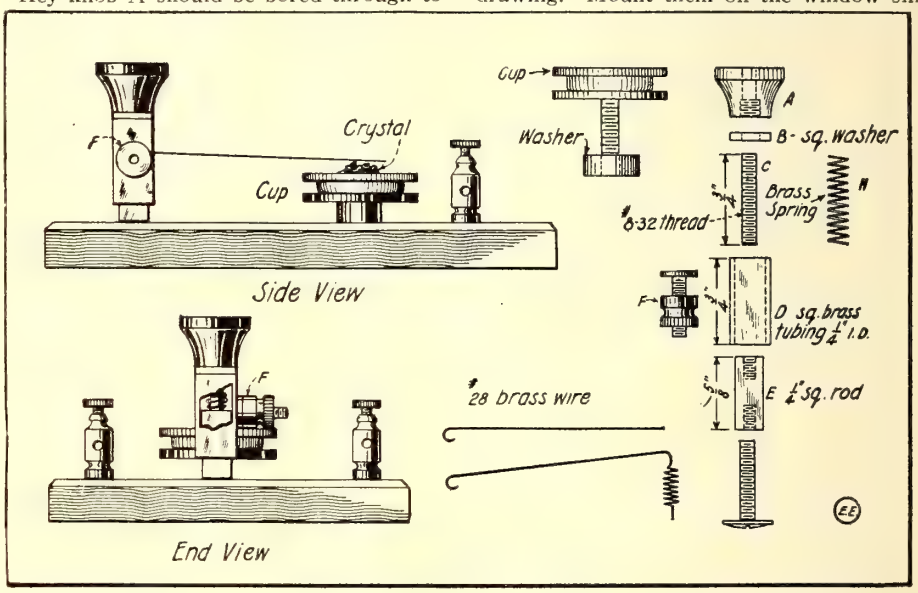
The following notes, in addition to the drawings, will explain the construction of this crystal detector. All materials not on hand can be bought at a nominal cost.

Key knob A should be bored through to the brass bushing to permit the passage of the threaded piece C. A square brass washer, B, is soldered on top of D and the binding post F to the side of D. This binding post can easily be made by filing down the head of a binding post taken from the zinc side of a dry battery. The square rod E is drilled and tapped at both ends to admit an 8-32 thread.

"Electro" sliding cup and slide make a very satisfactory device for holding the crystal, as the contact wire slants down to it, the pressure being regulated both by the knob and by sliding the cup.

This detector is adaptable for use with all crystals employing a wire contact for their operation.

Contributed by W. H. HALE.



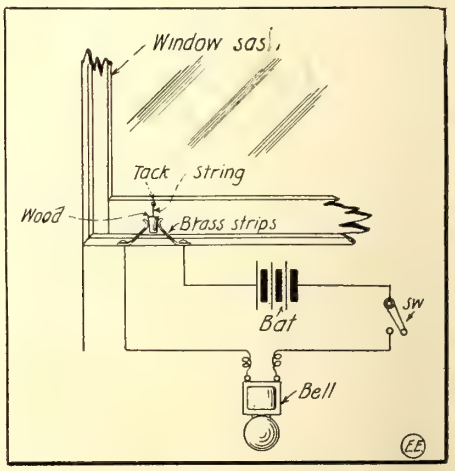
Second Prize: Clever Radio Detector for Using Galena and Other Minerals.

THIRD PRIZE $1.00.

NOVEL BURGLAR ALARM.

Herewith is a plan for a simple electric burglar alarm.

First, get two pieces of springy brass and bend them to the shape shown in the drawing. Mount them on the window sill so that the top part of each are touching together. Put a small strip of wood between them where they touch. Drive a small tack in the upper end of the strip of wood. On this tie a string, also attached to the window sash.



Third Prize: Electric Burglar Alarm for Windows.

When the window is raised it pulls the strip of wood from between the brass strips. This closes the circuit and rings the bell until it is turned off by a switch.

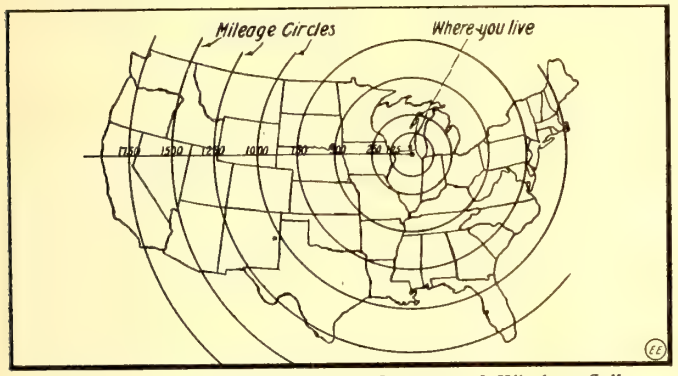
Contributed by HARRY HARVEY.

RAILROAD WIRELESS.

L. B. Foley, superintendent of telegraph, telephone and wireless, Lackwanna Railroad, New York, accompanied by Dr. Lee de Forest, left for San Francisco recently, to look into the merits of the Poulsen continuous wave system.

WIRELESS RANGE MAP.

Here is a diagram of a map that will help wireless operators a great deal. As I am a wireless operator, I find this map very useful in determining the distance between the sending station and receiving. I thought you might wish to publish it in your valuable paper, *The Electrical Experimenter*:



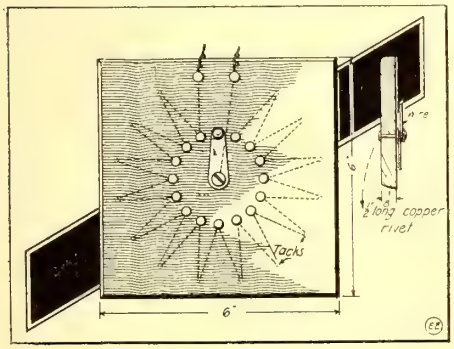
Range Map for Instantly Locating Distance of Wireless Calls.

First, I made a map of the United States; then I made circles, with *Malta*, Ill., as the center, because I live here, but the person who makes one must make his home the center, in order to find the distance in miles in all directions without any difficulty and at a glance tell the distance of the other station which is sending. I find it is very useful.

Contributed by WILBUR PHELPS.

HOME-MADE RHEOSTAT.

This is a description of a home-made rheostat: Make up a piece of wood 6x6 inches and ⅜ inch thick. Find its center and circumscribe a circle with a radius of 1⅛ inches. Lay off 18 points on this circle and on every point drill a little hole through the board, except the two points on the upper side of the board. After this take 16 ½-inch copper rivets and put them in the holes. Turn the board upside



Rheostat Composed of Few Feet of Resistance Wire and Copper Rivet Switch Points.

down and lay on every rivet a copper washer. Now get some high-resistance wire, such as iron, German silver, etc., attach on the first rivet and lay out at a sharp angle to the outside on the board and wind it in nearly two turns around the second rivet, and so on till the last rivet is finished. Now get a switch lever and attach to the center of the board. On the top of the board attach two binding posts: from one binding post connect a wire to the switch lever beneath the board; from the other binding post run a wire to the first copper rivet. Now lay on every copper rivet a washer and hammer the rivets down and the wire will fit tightly between the two washers. At last the whole board should be painted with a nice-looking color of paint. This little rheostat can be made at a very low price.

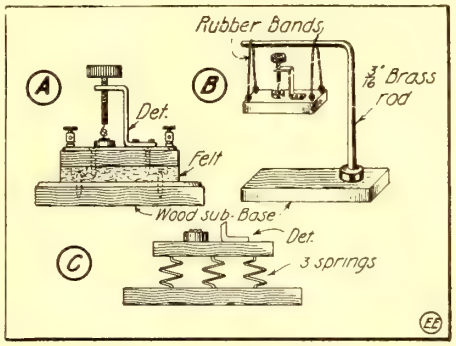
Contributed by JOHN BLANKE.

NON-VIBRATION MOUNTING FOR DETECTORS.

One of the principal troubles encountered when using wireless detectors of the ordinary type, such as those with delicate "cat-whisker" wires on them, etc., is that they are subject to vibration from tables, or even the building in which they are located. To overcome these troubles several schemes are shown in the sketch herewith.

At A the detector is so mounted on a piece of thick felt that no solid connection results between the base of the detector and the wood or other sub-base, which may be the table top.

A simple scheme to apply, and very efficient also, in the elimination of vibration transmission is that outlined at B, where the detector base or piece of wood fastened under its base has say, four small screw-eyes fastened at the corners of the same, with some rubber



Three Methods of Mounting Detectors Free from Vibration.

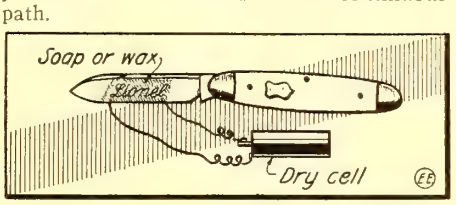
bands fastened over the brass arm as shown, so that the detector swings on the rubber bands.

Another simple way of overcoming vibration in the detector is to mount the base of same on three or four springs, as outlined at C in sketch.

ELECTRO COPPER COATED ETCHING.

Take five cents' worth of blue vitrol stones. Dissolve in one part of water and add two tablespoonfuls of salt, which makes the etching fluid.

Now, for the object to be etched: Take a knife blade, for instance. Take a piece of yellow laundry soap and rub on the knife blade until a thin coating is on the knife; then, with a sharp-pointed pencil or pin, scratch your initials or any other object on same. It should make a continuous path.



Copper Etching on Steel Blade.

Now pour the liquid just prepared on the blade until entire initial, or other object, is covered.

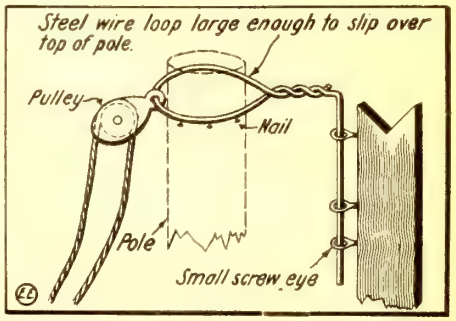
Take a common, dry battery and lay both wires in the liquid and leave for about two minutes.

Then rub soap off and you will have the initials, or other object, copper-coated and also etched into the knife blade.

Contributed by LEO G. DRISCOLL.

AN AERIAL POLE WRINKLE.

While it does not often occur, I should think somebody besides myself has had or perhaps will have trouble with the rope breaking or jumping the pulley on an aerial mast.



Simple Way to Arrange Aerial Pulley for Removal of Rope.

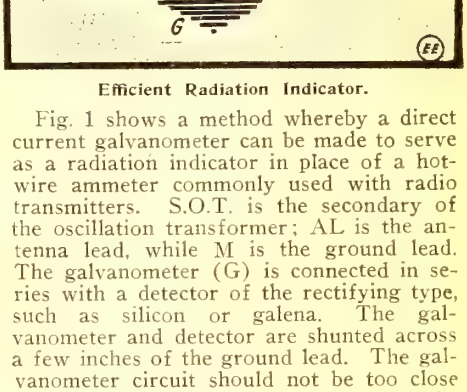
Recently I put a 35-foot pole in my yard, and the rope jumped the pulley, which kept it from being moved either up or down. I broke the rope in the attempt and thought it necessary to take the pole down, although it was firmly guyed. I at last devised the little scheme shown in the drawing, and with three clothes props and a little wire replaced the pulley with a new one threaded with new rope. Submitted by

RANDOLPH ROLAND.

THE GALVANOMETER AS A RADIATION INDICATOR FOR RADIO TRANSMITTERS.

By Wm. H. Dettman.

Nearly all sensitive galvanometers are only capable of responding to direct currents or to alternating currents of very low frequency, and therefore cannot be used in the regular way for measuring high frequency currents such as are utilized in wireless telegraphy.



Efficient Radiation Indicator.

Fig. 1 shows a method whereby a direct current galvanometer can be made to serve as a radiation indicator in place of a hot-wire ammeter commonly used with radio transmitters. S.O.T. is the secondary of the oscillation transformer; AL is the antenna lead, while M is the ground lead. The galvanometer (G) is connected in series with a detector of the rectifying type, such as silicon or galena. The galvanometer and detector are shunted across a few inches of the ground lead. The galvanometer circuit should not be too close to the transmitter. The detector must be adjusted to sensitiveness in the same way as when used with a receiving set; while making these adjustments the hand should not come in contact with any metallic parts of the detector, as this will interfere with the reading.

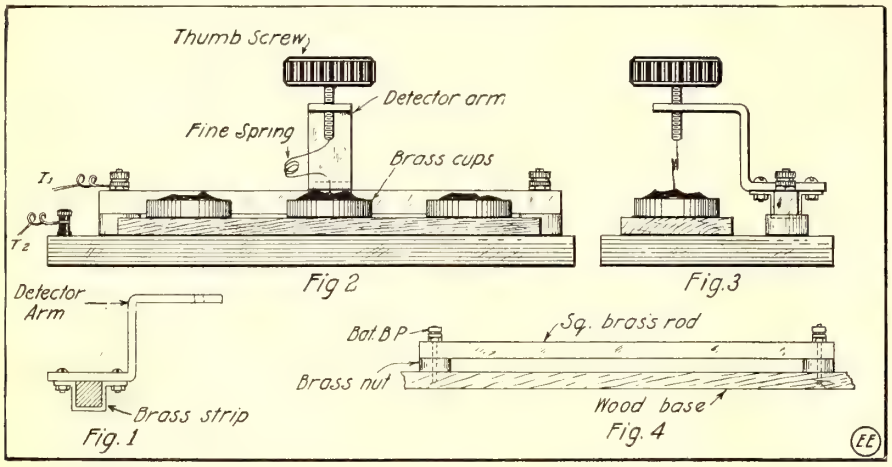
The above resonance indicator is superior to the hot wire meter in that it does not increase the resistance of the aerial circuit as the hot-wire meter does.

A NOVEL THREE-CUP DETECTOR.

Procure a piece of square brass rod ¼" square and 5" long and a detector arm including the thumbscrew.

A detector arm may be taken from an old detector which is not in use or may be purchased. The kind used on the "Electro" galena detector is very good.

Next, get a brass strip 1¼x¼x1/16" and bend it around the rod and fasten



Any Mineral at Once Available by Simply Moving the Vertical Arm Along the Slider Box.

to the detector arm as shown in Fig. 1.

The brass strip must not be so tight as to hinder the arm from sliding along the rod. A hole should be bored in each end of the rod and two holes in the base the same distance apart as those in the rod. The rod should be elevated from the base by placing a nut between the base and rod. Then the battery binding posts are inserted in the holes and tightened as shown in Fig. 4.

The base, which is 6x3x⅜", should be of fibre, but hardwood may be substituted.

Get three brass cups from the carbons of old batteries or they may be purchased from any supply house.

Get a wood or fibre block 4x1x¼" and bore a hole ½" from each end and one in the middle, just large enough so the cups may be pushed snugly into the holes. Screw the wooden block to the base under the thumbscrew and parallel with the brass rod, as shown in Fig. 2.

Then get three different minerals, for instance, silicon, galena and molybdenite, and place one in each cup. They may be fastened in same by packing tinfoil around them or by Hugonium Alloy. Connect all the cups together and to a binding post T_2.

Then connect the brass rod to another binding post T_1, and it is complete.

If you wish to use galena, you may slide the arm along until it is along side the cup in which the galena lies, etc.

More cups may be used, but the detector must be made longer according to the number of cups used. This detector saves the trouble of having more than one complete detector and a switch for them.

Submitted by
SHERMAN APPLEGATE.

A PLUG TYPE DETECTOR SWITCH.

The accompanying plan and description are of a very practical detector switch which the writer recently made, and is sending along for E. E. readers.

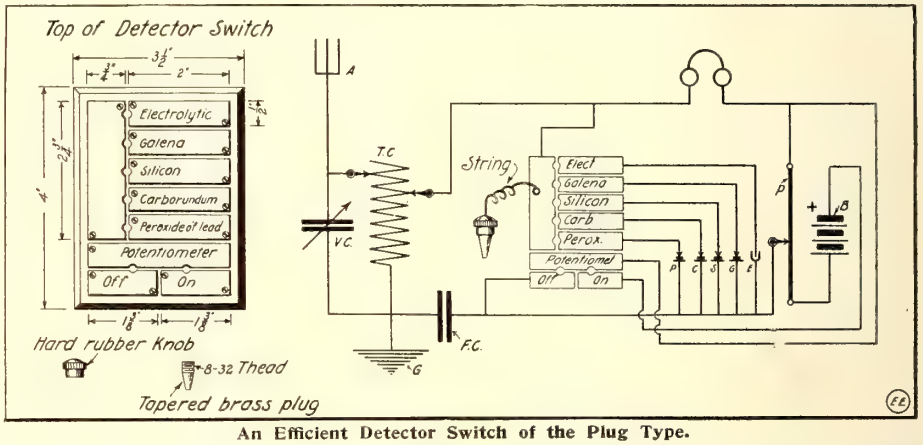
The switch is made of sheet brass and connections are made by means of small brass plugs.

The brass should be about No. 20, and the pieces mounted on a base, leaving 1/16" between them. The wires are soldered to the brass plates on the under side; thus making a very neat instrument.

The diagrams are self-explanatory and carry all necessary dimensions. Everything required may be procured from any electrical supply house.

If desired, each plate may have its corresponding detector name, etc, etched on them by coating the plates with wax, scratching the name in same with a sharp instrument and filling the grooves in the wax with acid. Afterward the etched grooves can be filled in with black enamel and the plate surfaces polished and lacquered.

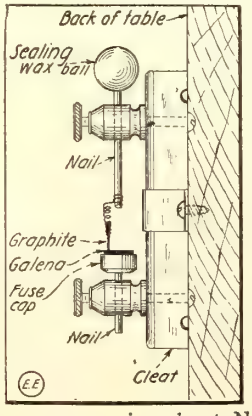
Submitted by
JAMES L. GREEN.



An Efficient Detector Switch of the Plug Type.

A SIMPLE WIRELESS DETECTOR.

After some experimenting with detectors, I evolved one, cheap and easy to construct, and hard to beat for sensitiveness and ease of adjustment, factors necessary in long distance receiving.



I have given a sketch showing its construction. Merely a two-wire cleat, two ordinary binding posts, two 8 penny nails, a brass cap from a fuse, some sealing wax and a short piece of lead from a hard lead-pencil; also a few inches of spring or copper wire about No. 30.

These are assembled according to the drawing. The two posts are mounted in the holes in the ends of the cleat, then cut one nail off 1" from the head, solder brass cap to it, cut other nail off about 2" from head, dip the head in melted sealing wax and turn it slowly; this will form a handle. Make connections to back of posts, then clamp cleat against back of table with a brass strip ½" wide, slip shorter nail with cap into lower post, slip other nail in upper post, then fasten the lead to the upper nail by means of some fine wire. Place a piece of galena in the cup and pack it tight with small wads of tinfoil and adjust.

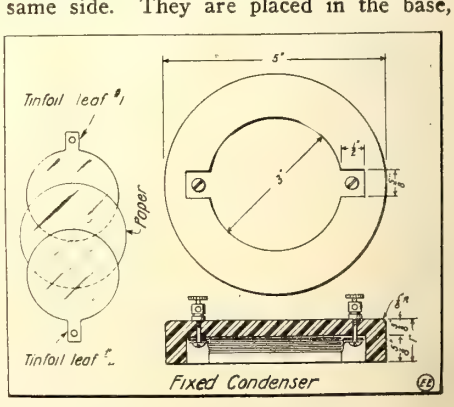
It is important that the lead have a very sharp point touching the galena.

Contributed by
THOS. W. BENSON.

A RADIO BLOCKING CONDENSER.

Here is a description of an effective fixed or blocking receiving condenser. The wood used in the construction of this condenser is preferably one that takes a high polish, such as mahogany or oak. A circular piece of wood 5 inches in diameter is turned up with a hole in the center 3 inches in diameter, having a depth of ¾-inch. Slots on the side of this are made to allow space for the lugs of tinfoil and the binding posts.

Twenty sheets of tinfoil are cut out with a diameter of 2½ inches, having lugs ⅝-inch wide and ½-inch long. Twenty-one circular pieces of paraffin paper are made 2¾ inches in diameter. The tinfoil and paper are placed alternately upon each other, so that every other lug lies on the same side. They are placed in the base,



Blocking Condenser Made from Tinfoil and Paper in Circular Wood Base.

binding posts are inserted and the remaining space is filled with paraffin.

The dimensions are given in the diagram.

This condenser presents a neat and pleasing appearance and is a valuable addition to any receiving set.

Submitted by PERCY M. ROOPE.

U. S. PATENT OFFICE

IMPROVED SELENIUM CELLS.

In an article in the *Physical Review* Mr. D. S. Elliott describes a new construction of selenium cells, due to Pfund. It is particularly adapted for low-temperature work. Amorphous selenium was first cast into discs about 1.5 cm. in diameter and 1.5 mm. thick. They were sensitized in the usual way, being maintained at a temperature of 200 deg. C. for six hours and then cooled rapidly to room temperature. The



Fig. 1.

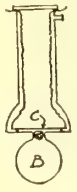


Fig. 2.

discs were then ground smooth on crocus cloth, after which silver tape electrodes were fastened on with celluloid. A film of gold was next deposited by cathode sputtering, and finally the gold was removed along a narrow line like a grid as shown in Fig. 1. No deleterious action due to mercury vapor could be detected. The cell was finally inclosed in a glass tube similar in design to that shown in Fig. 2. The smaller bulb was filled with calcium chloride and the constriction leading to the upper chamber was loosely plugged with cotton. The cell was fastened with sealing wax in this upper chamber, the end of which was closed by a glass plate. The vessel was also provided with a side tube for exhausting by means of an aspirator, a phosphorous pentoxide tube being inserted between cell and aspirator during the process.

IRON CONDUCTORS INSTEAD OF COPPER.

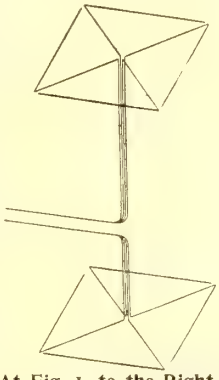
The present European war brings to the front the somewhat unfamiliar idea of using iron and steel wires for overhead conductors and even for other purposes. The effect of the war in cutting off the importation of copper from Germany has been considerable—just how great it is quite impossible to tell, but great enough to raise the question here discussed. Tests made both for direct current and alternating current have shown that in using relatively small wires with low-current densities the iron conductor can be made surprisingly effective, even for alternating currents, when the matter of cost is taken into account. So effective is it, indeed, that at a possible ratio between the cost of iron and that of copper; conductors of the former material may pay well. It is only when the conductors are of the larger diameters and carrying considerable current that the serious effects of the change in material become conspicuous. While at home the cost ratio of iron as compared with copper is unfavorable, yet, if a recent quotation reported from Germany of $600 a ton be correct, the balance may well be turned in the other direction.—*Electrical World.*

TIME-FACTOR IN SELENIUM RESISTANCE.

The Time-Factor in Selenium Resistance is covered in the "Physical Review" for Sept., 1914, in an article by G. E. Grantham. It is well known that the electrical resistance of selenium does not reach an equilibrium value instantaneously after exposure to light, and the rate of change of resistance on exposure is much greater than the recovery rate. The problem suggested the use of a rotating disk from which sectors are cut to allow the light to fall upon the cell, the cell being in one arm of a Wheatstone bridge with some device for connecting a galvanometer in the bridge circuit at a known time interval after exposure. The author describes experiments made by this method. The relation between time and resistance for the preliminary experiment is shown in curves. During the first hour the rate of change of resistance increases with the speed. During the remainder of the time the cell approaches the equilibrium resistance. This equilibrium resistance is the resistance of the cell at the time that the decrease on exposure is just equal to the increase in the dark. A discussion of the results is given on the assumption that selenium consists of three components.

INTERNATIONAL COMMISSION ON RADIOTELEGRAPHY.

Below we give part of a discussion by William Duddell of the proposed work to be undertaken by the International Commission on Wireless Telegraphy. At the sending station it is necessary to measure the antenna current, which requires ammeters suitable for high frequencies and strong currents up to 150 amperes at least. Hot-wire instruments must be used. The author proposed the arrangement shown in Fig. 1. It consists of two copper tubes, on each of which a series of notches is made. A thin wire passes in zigzag fashion from one notch to another, as shown in the illustration, so as to form a kind of squirrel cage. The two tubular electrodes are given a rotary movement with regard to one another, causing the wires to fall on the surface of a hyperboloid of revolution. Two wires are stretched along the axis of the hyperboloid and joined together in such a way that the weld (giving a thermocouple) is at the central part of the narrowing or contraction. These wires are taken to a millivoltmeter. With an instrument of this kind an e.m.f. of 5 millivolts is obtained when a current of 150 amperes passes. The nature of the antenna to be used at the control station requires very careful consideration, in order that changes, for instance, in the earth may not affect the accuracy of the results. Probably Lodge's type of antenna, as shown in Fig. 2, is best. On the other hand, it might be well to see whether a receiver with closed circuit, such as has been described by F. Braun, might not be better. Among its other advantages is the fact that the properties of the circuit could be defined very exactly and kept constant. At the different receiving stations it is necessary to determine the strength of the signals that are received, partly with a view to comparing results from day to day and partly to compare the results which are obtained at the different stations on the surface of the earth.



At Fig. 1, to the Right, New Form of High Capacity Hot Wire Meter. At Fig. 2, to the Left, Lodge Balanced Antenna Proposed for Quantitative Test.

Electricity is used to locate the bullets in the European war victims.

ANENT THE TUNGSTEN LAMP.

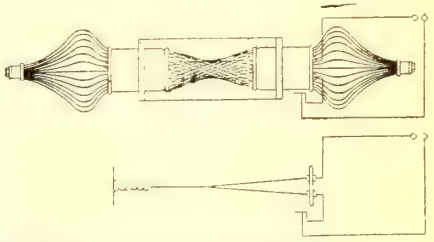
Four years ago three carbon lamps were sold for every Edison mazda lamp; to-day 12 Edison mazda lamps are sold for every carbon lamp. If all the filaments used in the Edison mazda lamps manufactured in 1913 were made into one length they would stretch for 50,000,000 feet, or nearly half way around the earth, says the *Edison Business Builder.*

WEAR ON OVERHEAD TROLLEY WIRES.

An illustration of the wear which takes place on overhead trolley wires occurred on the Blackpool Corporation Tramway system (English) recently, when a length of nine miles of wire was renewed. A one-yard length of the old wire, which has been in use 12 years, was found to have lost 55 per cent. of its original weight, says *The Electrician,* London.

SOME "ENGLISH" SHORT CIRCUITS.

Contributions to this section (in the shape of definitions of well-known electrical objects) are invited from the witty members of the industry, says *The Electrician,* London. "Hot plates" will be awarded from time to time for the best efforts, and we give below some of the first efforts:



D. C. Turbo-Generator: A machine with a past, valueless as a present, and without a future (try A.C. Turbo-generator).

Gas Engine: A mechanical monstrosity, of which it has been rightly said that the connecting rod is often in doubt as to the direction it was intended to take.

Centrifugal Pump: The practical embodiment of the science of rotating squirts.

Wattless Currents: The fruit of the Watt-le (see also What'll ye have).

Professor: One who professes something, sometimes to teach, more often to know. May also act as consulting engineer.

Dry Cell: A cell which is of no use unless it is kept moist (vide Scotchman).

Commission: Money paid not willingly, but grudgingly and of necessity.

[Ed. Note.—*What have our readers to say? Suppose you think up a few good electrical definitions on this order. If good enough we will publish them.*]

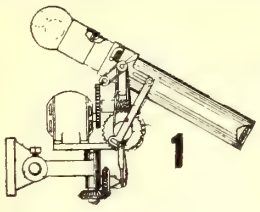
THE COOPER HEWITT MERCURY OSCILLATOR.

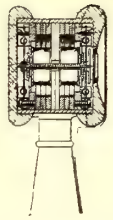
Dr. Peter Cooper Hewitt has announced completion of the preliminary work on a new development of his well-known mercury-vapor lamps and rectifiers. The new inventions involve improvement on the vacuum-tube rectifier for feeble high-frequency currents, such as occur at the receiving station of a radio-telegraph or radio-telephone system and the development of an oscillator or converter which efficiently transforms direct current or low or high voltage into sustained

(*Continued on page* 27.)

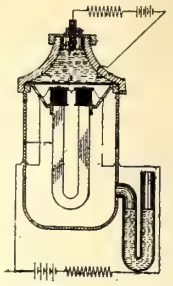
LIBRARY

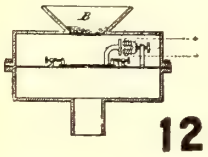
LATEST PATENTS











ADVERTISING LAMP (Fig. 1)—A motor continuously moves the lamp tube up and down; the tube projecting an image on the sidewalk, etc.

TELEPHONE RECEIVER (Fig. 2)—Novel receiver in which opposite balancing effect acts on spring-supported armature. Two magnet coils are used.

ELECTRIC AUTO SIGNAL (Fig 3)—A rear signal for autos, comprising arrow heads illuminated when auto is to turn corners. Center lamp lights license number.

ELECTRIC RELAY (Fig. 4)—A relay comprising a diaphragm for receiving vibrations, and a fluid medium for transmitting said vibrations from said diaphragm to secondary circuit.

BATTERY CONNECTOR (Fig. 5)—Improved connector cable and lugs with split springs, preventing nuts from vibrating loose.

STORAGE BATTERY PLATE (Fig. 6)—Scheme to have all vertical ribs in plate point toward a hypothetical center of electrolysis distribution, O.

A. C. VIBRATING RECTIFIER (Fig. 7)—Has a vibrating armature, 21, corresponding in period to the A. C. frequency. Hence will pass + and miss — waves, and deliver D. C. to storage battery, 7, etc.

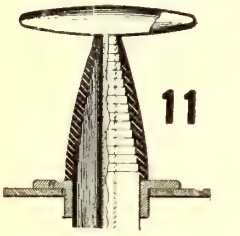
MAIL BOX ALARM (Fig. 8)—Alarm with bell, switch and battery. Closed cover tell-tale, rings bell and moves indicator to read "Mail."

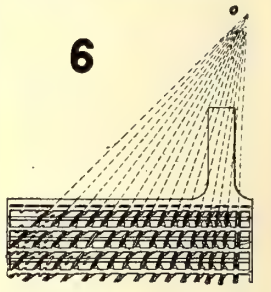
CURIOUS ELECTRIC MOTOR (Fig. 9)—Three suction type electromagnets act on crank pin disc alternately to rotate shaft. Includes switching gear.

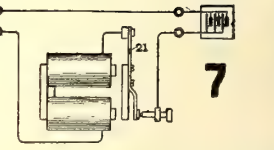
ELECTRIC HORN (Fig. 10)—Simple horn, actuated by electric buzzer joined by resilient spring between armature and horn diaphragm.

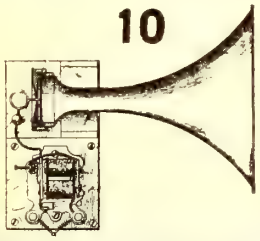
NOVEL ELECTRIC INSULATOR (Fig. 11)—Terminal insulator with condenser leaves wrapped around it, shaped to conform to electrostatic field about it.

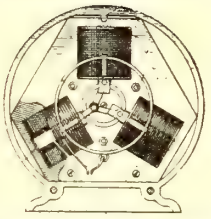
ELECTRO-PNEUMATIC SOUND BOX (Fig. 12)—A blast of air is fed into the lower pipe. Electromagnet actuates a gate valve. Escaping air vibrations pass out horn, B, giving rise to sound. Amplifier principle.

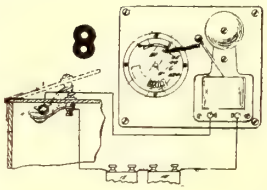






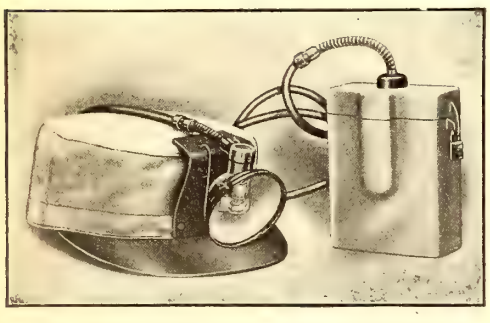






ELECTRIC HEADLIGHT FOR MINERS.

The miner of this era has a much more efficient and agreeable source of light available than his brother of other days. Then it was the oil lamp, with its attendant odors and unsteady, flickering beam. The modern electric miner's headlight is a great boon, indeed. A typical form of standard



Electric Headlamp for the Miner. Storage Battery Supplies Current.

equipment for these requirements is here illustrated.

The battery used is a small storage cell of several plates, placed in a leak-proof, vulcanite container or tank. Two wires lead up from the battery, placed at the miner's waist in the rear, to the headlight arranged for fastening to his cap, as shown. Suitable switch is provided to open and close the lamp circuit. This outfit is highly developed in its details so no undue trouble will be experienced from acid leaking out of the battery, etc. The terminals of the battery are so made as to be acid- or corrosion-proof. Hundreds of the batteries are charged at one time in a battery house. Usually the cells are joined in series while charging. One charge will last a day.

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and many new and original features will be found in it.

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HAVE YOU AN IDEA?

Are you using a new device or an improved modification of such, in your wireless or electrical laboratory? If so, why not write it up and send to us with a photo or sketch? Drawings invariably have to be made over by our draughtsmen, and just so you express your ideas concretely and as briefly as possible, we are always glad to publish them, when the article possesses merit. Look over this issue carefully, re-read the articles twice, and you will soon pick up the knack of writing articles, and, moreover, we pay you well for your efforts. Why not get busy to-day and get in the swim? Be a live, wide-awake Electrical Experimenter! Boost your paper and boost yourself. It's very easy!

Make all sketches on separate sheets of paper, and write only on one side of your text sheets. Address the Editor.

HOW TO BIND "ELECTRICAL EXPERIMENTER" COPIES.

A simple method to bind copies of the *Electrical Experimenter* together is as follows: On the side where the leaves of the magazine are bound together punch two holes, one at the top and one at the bottom. Do this to all of the magazines and then put ordinary paper fasteners through these holes and bend the ends over.

Contributed by EARL HUGHES.

AMONG THE AMATEURS

Our Amateur Radio Station Contest is open to all readers, whether subscribers or not. The photos are judged for best arrangement and efficiency of the apparatus. To increase the interest of this department we make it a rule not to publish photos of stations unaccompanied by that of the owner. Dark photos preferred to light toned ones. We pay each month $3.00 prize for the best photo. Make your description brief. Address the **Editor.**

AMATEUR RADIO STATION CONTEST.

Monthly Prize, $3.00.

This month's prize winner.

WIRELESS STATION OF HARRY WEBER.

Sending condenser: Open rack type, consisting of 14 plates 16x18 inches connected series-parallel, with eight knife switches to vary capacity. Mounted in hardwood rack. Have completed oil-immersed condenser since photo was taken.

Rotary spark gap: Twelve discharging points on aluminum disc, driven by 1/10 H. P. Robbins & Meyer's motor, with Cutler-Hammer rheostat.

Oscillation transformer is composed of two spirals of heavy brass ribbon. Have Brandes hot-wire ammeter reading 0 — 5 amperes. I use anchor-gap and aerial switch that controls rotary gap; also have heavy wireless key. I get a reading of 4 amperes on hot-wire meter.



The aerial of my station is composed of four strands of 7-22 phosphor bronze cable, 70 feet high.

Transmitting set consists of 1 kw. commercial transformer, closed core, with six variations of power. Secondary voltage, 16,000.



Prize-winning Radio Station of Harry Weber.

The receiving set comprises: Loose coupler with primary and secondary tubes of Bakelite with six taps on primary and 10 on secondary. One variable can be thrown in series or shut in primary circuit; other variable in shunt with secondary. Cabinet is finished in black and is hand-rubbed and highly polished. Use storage battery to light audion filaments. I am getting good results with this set, and hear many amateurs within a radius of 500 miles. I can read a ¼-kw. set 300 miles distant and a ½-kw. set almost 800 miles away. Stations within 300 miles copy my signals strong, and I am heard at distances of 600 miles. I made all the instruments except the transformer. My call is 8 AM. Would like to arrange tests with any amateurs that hear me. Yours truly.

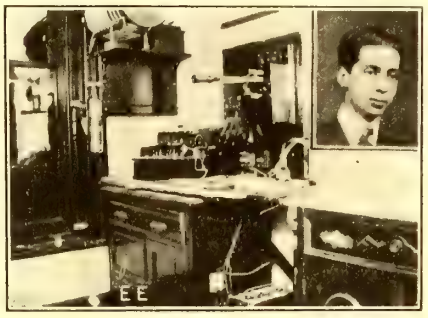
Canal Dover, O. HARRY WEBER.

BARRUTTE RADIO STATION.

The accompanying photograph shows part of my radio station which I desire to enter in your monthly prize contest.

The receiving set consists of a Marconi inductively tuned cabinet set. The tune can be changed from direct to inductive by a rocker switch. The detector is of the crystal type, and can be adjusted very quickly, and it is aided by a set of batteries and a potentiometer. The capacity used consists of a variable and fixed condenser. A loading coil and phones complete the set.

The set will respond to wave lengths of 15,000 meters. The sending apparatus consists of a 6-inch spark coil operated on 24 volts. The primary circuit is com-



Mr. Barrutte's Radio Outfit in Brooklyn, N. Y.

pleted by a navy type key, which is seen in front of the relay. The condensing unit consists of Murdock moulded condensers and a flanged air-cooled gap. The tuning is accomplished by an oscillation transformer. The antenna switches are shown on the switchboard. I have been picked up at New Canaan, Conn., by M. B. Porter, who has a large radio station there.

I can just about copy "NAM." My official call is 2PC.

L. BARRUTTE.

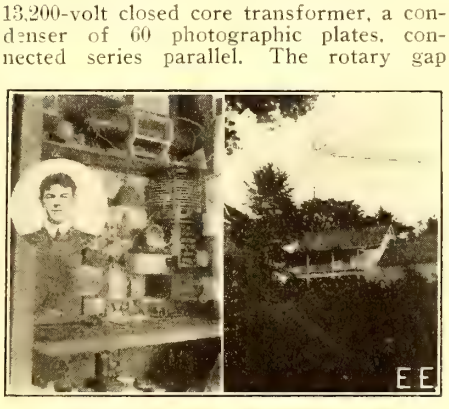
Brooklyn, N. Y.

STUART RADIO SET.

Below is a photo of my wireless station and electrical laboratory, the aerial and also a small one of myself.

My aerial, 108 feet long by 60 feet high, is composed of four strands of seven-strand copper wire spaced on 10-foot spreaders. It is grounded when not in use by a 100-amp. switch.

The transmitter consists of a ½-kw. 13,200-volt closed core transformer, a condenser of 60 photographic plates, connected series parallel. The rotary gap



Stuart Wireless Station and Aerial.

has 12 aluminum plugs and runs about 4,000 revolutions per minute. The oscillation transformer is of my own design and construction, and the wires are Nos. 6 and 8 aluminum, respectively.

The receiving set is of the cabinet type, and is complete by itself. It contains a 3,000-meter loose coupler wound with Nos. 24 and 32 wire, a loading coil, two fixed condensers, one rotary variable condenser, a Galena detector of the catwhisker type and a buzzer test. I also have a buzzer in the attic controlled by a push button within easy reach of my foot. My phones are 3,000-ohm Murdock type. I can hear NAA at noon with my phones several inches from my head. I have a license and my call letters are 1BG.

The large Tesla coil at the top of the picture was constructed similarly to one described in this paper a few months ago.

I have been a reader of the *Electrical Experimenter* for the past two years, and am pleased to see it growing in size and wish it came weekly instead of monthly.

H. CORCELL STUART.

St. Johnsbury, Vt.

RADIO STATION OF C. L. ROBINSON.

I give you herewith photo and description of my wireless station. Most of the apparatus are of Commercial make or made by myself. The outfit consists of the following instruments: One-inch Bulldog spark coil, one-pint Leyden jar, quenched and open spark gaps, key, aerial switch and five dry cells. Receiving outfit: Loose coupler of my own make, silicon detector, variable condenser made of two tin cans



C. L. Robinson and His Wireless Laboratory.

for use across L. C. secondary, one 1,000-ohm receiver, receiver shunt condenser and necessary switches. All the instruments are of my make except the spark coil, receiver and Leyden jar.

My aerial consists of four No. 12 galvanized iron wires 100 feet long, 20 feet high at one end and 25 at the other, with two lead-in wires from center, making a "T" aerial. The spreaders are 10 feet long. I have a brother living about one-quarter of a mile away and a neighbor who lives about one mile from one, both of whom have stations which I can hear fine. I also have a friend about four miles south of me who is putting up a station. I live in the Ozark Mountains in a valley, with hills on each side about 300 feet high, which accounts for me not being able to receive any great distance. I have tried grounding contact side of detector, which brings in signals considerably louder and some you can't hear at all without the ground. C. L. ROBINSON.

Laquey, Mo.

Submarines use electricity to propel them under water.

QUESTION BOX

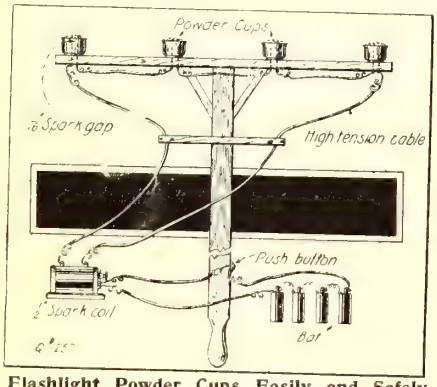
This department is for the sole benefit of the electrical experimenter. Questions will be answered here for the benefit of all, but only matter of sufficient interest will be published. Rules under which questions will be answered:

1. Only three questions can be submitted to be answered.
2. Only one side of sheet to be written on; matter must be typewritten or else written in ink, no penciled matter considered.
3. Sketches, diagrams, etc., must be on separate sheets. Questions addressed to this department cannot be answered by mail.

SPARK COILS FOR FLASHLIGHT IGNITION.

(257). D. A. Biggard, Frankford, Philadelphia, Pa., wishes to know about a spark coil for use in igniting photo flash-light powder?

A. 1. We would suggest a ¼" spark coil for your work, in igniting flash powder. You may use some No. 16 or 18, twisted lamp cord for connecting the battery, etc.



Flashlight Powder Cups Easily and Safely Ignited by Means of Spark Coil.

We believe you would find a ½" coil best if you intend to use several spark gaps in series, as your sketch indicates.

Diagram is given herewith showing how to connect up one of these coils for the 4 powder cups.

PLUNGER ELECTRO-MAGNET PULL FORMULA.

(258.) W. Le R. B., New York, has some solenoid or plunger electromagnets to build and wants to know how the strength of same can be computed?

A. 1. We give you herewith formula for calculating the pull in pounds for any length action of solenoid magnet on direct current; and you can thus readily compute the power of same.

The pull in lbs. of a D-C. solenoid is:—

$$P = A\,I\,N\left[\frac{I\,N}{l_1 c^2} + \frac{C}{l}\right], \text{ in lbs.}$$

In which: A is area core section in sq. in.; I is current in amperes; N the number of turns of wire; *la* the length of air-gap in inches; *l* the length of the coil inches, while *c* and C are constants. For soft iron cores at ordinary flux density, c=2660 and for *l* greater than 10 dia. coil; C=0.0096. For full details on this subject with design curves from actual magnets built, see Underhill's "Solenoids and Electromagnetic Windings," which we can supply at $2.25 postpaid.

WATCH DEMAGNETIZERS.

(259.) Berries & Co.,——; please give us full details on how to make a "Watch Demagnetizer" for direct current, 110 volts.

A. 1. Refer to the September, 1913, issue of this journal; worth five cents. Other numbers of *The Electrical Experimenter* can be supplied as follows: 1913 numbers, excepting May, June, July, or October; 1914 numbers, excepting January issue; price five cents straight, the copy, prepaid.

1-4 inch COIL CONDENSER.

(260.) Alan C. Rockwood, Iowa City, Iowa, states that his small ¼" spark coil sparks excessively at the vibrator and wants to know the remedy.

A. 1. This is most probably due to a breakdown of the primary condenser. A condenser suitable for this purpose may be composed of about 18 sheets of waxed paper, covered on both sides or interleaved with tin-foil sheets about 3 inches square; leaving ⅜ inch margin of paper around the tin-foil. Connect every other foil leaf to either side of the vibrator, alternately; i. e., 9 sheets to each side.

In regard to the small rheostat, would say that the voltage drop of same may be figured from the resistance which is 10 ohms and the current capacity which is 2 amperes at full load; or the volts drop equals Res. × Current, or 10×2=20 volts drop.

Want to Swap?

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LIGHT ACTION ON SELENIUM.

(261.) A. J. Hain, Lakewood, Ohio, inquires as to the action of light on selenium, partly covered over with an opaque shutter or screen, etc.

A. 1. Relative to the action of Selenium Crystals, etc., would advise that wherever the Selenium is covered over with some light-proof material, the Selenium at that point will become of very high resistance. Of course, a slight effect will probably be made on the Selenium so covered by reflection from the uncovered surface of same, as you intimate.

As a matter of fact, it has generally been found that the resistance of Selenium Cells varies pretty well in proportion to the amount of light thrown on same.

Selenium in stick form, chemically pure, may be purchased on the market. However, its resistance is infinitely high in the pure state. It has to be fused, crystallized and carefully annealed before its action is the same as in standard cells.

You will find considerable information on Selenium Cells and their construction in the August, 1914, *Electrical Experimenter.*

RADIO CIRCUIT PROTECTION.

(262.) Dayton D——, Limon, Colo., mentions the use of small fuses for protecting wireless sets from static aerial currents:

A. 1. Fuses are hardly ever used in protecting radio receiving apparatus from static or lightning discharges, and the common method of giving such protection is to connect an anchor spark gap about 1/100 of an inch long, across the aerial and ground wires where they join the receiving set. This system is used in the United States Navy, and also on most commercial installations.

There is no law stating definitely that you may not use a stationary spark gap, and these can be employed for short range wireless transmitters, where they do not send over the border line or interfere with the interchange of government or commercial radio messages over such State boundary line.

A. C. QUESTIONS.

(263.) A. L. Franklin, Chickasha, Okla., asks several questions on A.C. motors, transformers, etc.:

A. 1. Twice the size of wire now used on the coils on your 60-cycle A.C. motor, should be employed for the new winding and consequently one-half the number of turns should be placed on same, for 120 cycles frequency. You may figure the circular mils area of any wire from the Brown & Sharp wire table given in most textbooks and catalogs.

It is probably best to connect two receivers with widely different resistances on multiple, but two high resistance receivers should be connected in series and the same holds true for a pair of similar type, low resistance receivers.

The wave length of loose couplers, is explained in detail in the September, 1914, issue of *The Electrical Experimenter.*

Any transformer will show a small consumption of current on watt-hour meter in the primary circuit; even though the secondary is open circuited. This small current consumed by any transformer as mentioned, is known as the magnetizing current.

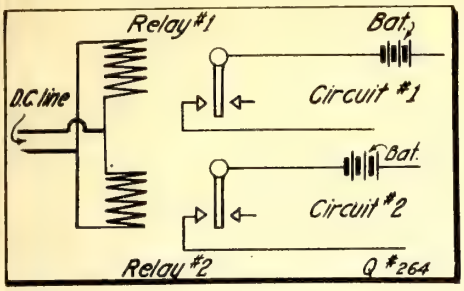
POLARIZED RELAY PROBLEM.

(264) Walter J. P——, Grand Rapids, Mich., asks us about using 2 single polarized relays, etc., to signal when direct current is passed through the circuit in a positive or negative direction and vice versa. Relays to remain open when no current traverses control circuit.

A. 1. Relative to the use of polarized relays, special circuits, etc., we may say, first, that you can employ a couple of the plain polarized relays hooked on to the circuit in parallel as shown in the diagram.

If you wish to have one relay of the dif-

ferentially wound type act to close a local circuit, when positive or negative current is passed through the coils of same, you will have to arrange the armature with balancing springs on either side; so that nor-



With no Current in D. C. Line, Polarized Relays 1 and 2 Remain Open. Positive or Negative Current Through D. C. Line Closes Respective Relay.

mally or with no current in the magnet coil circuits the armature will rest midway between the two platinum contact screws of the relay. About six to seven milli-amperes are required to operate these relays.

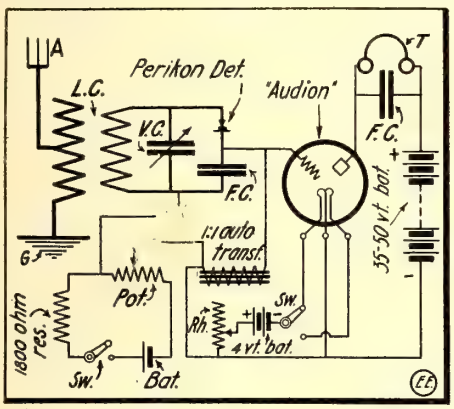
AMPLIFIER HOOK-UP.

(265) J. W. Halligan, New York City, asks us:

Q. 1. Is the diagram I show correct for using an Audion to amplify the wireless signals as received on a crystal detector, such as the Perikon?

A. 1. The diagram you show is not correct. We do not believe it would work at all. We give you below proper diagram showing how to arrange a single Audion bulb to amplify from a Perikon Detector, and it is claimed that this arrangement will yield as high as 20 amplification factor.

The diagram is quite plain and needs no lengthy explanation. The auto-transformer of 1-1 ratio shown should have about 9,000 ohms resistance and is very well composed



Audion Amplifying From Crystal Detector.

of three or four spark coil secondaries. These should be placed end to end with a common soft iron wire core passed through their center. A Perikon detector is suggested as best for the purpose, and the potentiometer shown is for adjusting the battery current applied to same.

D. C. DYNAMOS.

(266) Frank Moore, Kemp, Tex., wants advice on small D. C. dynamo building.

A. 1. On the matter of small dynamos and their windings, etc., we refer you to the excellent 25c. book by Marshall, which we supply, entitled, "Small Dynamos and Motors and How to Build Them."

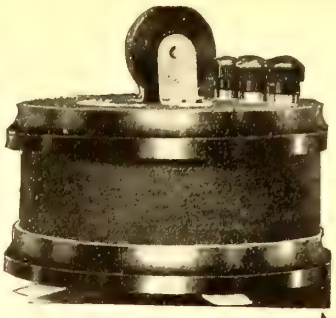
We may say that in general, with a given size of armature, it is rarely possible that you can gain any great amount in output from the machine by increasing the field strength to any extent; providing, of course, the field is of sufficient strength in the first place, all things considered. This is due to the basic fact that the output in amperes of

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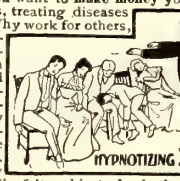
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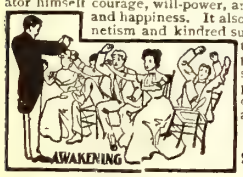


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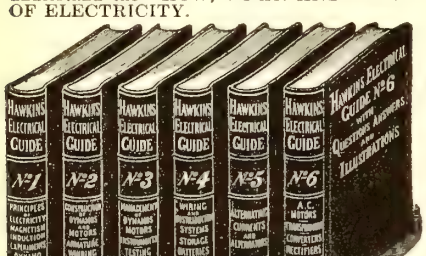
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the armature, and conjointly of the dynamos, depend upon the size of the armature conductor or wire. This is invariably figured for D. C. machines at 600 circular mils per ampere of armature current. You can thus readily figure the capacity of any armature from a common wire table as given in any text-book, catalogues, etc.

With an armature having two field poles and two brushes on the commutator, there is of course provided two divided paths through the armature for the current, and each half of the armature would thus carry one-half the total current; that is to say, that if the armature was to develop or handle a total current of 100 amperes, then each half of the armature winding would carry 50 amperes, or the armature winding would be designed to have a cross-sectional area of 50 times 600 circular mils.

TRANSCONTINENTAL TELEPHONY.

(267). A. L. Franklin, Chickasha, Okla., wishes to know the strength of current used in telephoning across the continent.

A. 1. We may say that 48 volts from a storage battery is the principal current used in sending speech from New York to San Francisco over the Bell system. However, this current works through an Audion type amplifier, and the secondary or wing circuit of the amplifier has about 100 to 110 volts battery current in same.

A. 2. In regard to the human body having a resistance of, say, 5,000 ohms or more, measured from hand to hand, and the effect of applying 50,000 volts through this circuit from a small induction coil, will say that as the coil could only deliver a small fraction of an ampere, you could not, of course, cause any greater current than a minute fraction of an ampere to flow. Shocks from spark coils are always very unpleasant, and in the case of some persons the discharge from a fairly large spark coil may indeed prove fatal.

RANGE OF RADIO STATIONS.

(268) Orval Shryock, Box No. 1, Brighton, Ia., asks about the range of radio stations.

A. 1. We do not quite understand your query as to how far a certain radio receiving station can operate over, but may say that it must have an aerial large enough and instruments of sufficient sensitivity to pick up so many micro-watts out of the ether or from the transmitted etheric wave.

To make this matter clearer, we will suppose that you have an ordinary amateur station located on the Atlantic coast of the United States. Now, suppose that you try to pick up the wireless signals from the Eiffel Tower. Undoubtedly, you will not be able to accomplish this unless you have a particularly large aerial, say 1,500 feet long, with the very best instruments, including some form of amplifier. However, we may remark that several commercial and private radio stations of the very highest character in design, etc., located around New York City, pick up the Eiffel Tower repeatedly, and also hear the German stations working regularly every day; whereas the small amateur stations cannot do this, as their instruments are not of sufficiently high sensitivity and efficiency, and also their aerials are entirely too small to pick up sufficient energy. About 30 to 40 micro-amperes in the receiving station aerial circuit will give good signals on a first grade set.

AERIAL ANTENNA CURRENT.

(269). Wm. Rogers, Ohio, Ill.

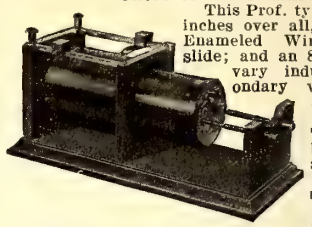
A. 1. The transmitting range of a wireless station depends in general upon the amount of watts expended in the antenna. In fact, it is given by the following for-

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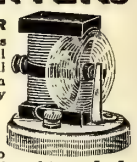
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mula, wherein I^2 is the current in the antenna as read on a hot wire ammeter; R O is the actual or ohmic resistance of the antenna circuit, and R D is the radiation resistance of the antenna circuit. This latter term, R D, is usually about four times the ohmic resistance. The watts radiated $= I^2 \times (RO + RD)$. As you will perceive, this expression really takes into consideration the watts in the circuit. About 10 watts to the mile may be figured on for small and medium size plain sparks gap type transmitters, with closed core transformers.

LONG DISTANCE RADIO RECEIVING.

(270) F. L. Peoples, Jacksonville, Fla., writes us about a receiving set for transatlantic service.

A. 1. With reference to reciving transatlantic messages, will say that undoubtedly for this work you will have to use a pretty large aerial, one having, say, a length of 1,000 to 1,500 feet and composed of a couple of strands of phosphor bronze cables.

This stretch of wires should be elevated 150 to 200 feet, and preferably more, above the ground, and the wires should be spaced about 20 feet apart and well insulated; also, in such an event you will have to use the very best phones possible, and undoubtedly some form of amplifier, unless your radio receiving set is particularly efficient.

LAMP BULB EXPERIMENT.

(271) Russell Baley, Hillsboro, Wis., states that he tried lighting an incandescent lamp bulb from the secondary terminal of a spark coil, and wants to know why the filament in the bulb was attracted to the glass.

A. 1. The effect you describe with regard to holding an ordinary 16 C. P. electric light bulb in your hand near a spark coil is a common one and familiar to all electrical experimenters. Most probably the reason why the filament in same is drawn toward the glass wall is due to the fact that the human body gathers an electric charge, and this is spread over the outside of the glass on the bulb. This charge, of course, tends to attract the charged filament inside the bulb by electro-static action.

A. C. TRANSFORMERS FOR TELEGRAPHY.

(272) D. A. Hoffman, Akron, O., inquires about using small A. C. step-down transformers for a short telegraph line instead of batteries.

A. 1. You may use step-down low-voltage transformers for the telegraph line you are interested in. You can use a ground return if desired, and if an accidental short circuit exists on the line very long it is liable, of course, to burn out the transformer windings. You should in this case place a very small fuse wire or link in the secondary circuit to protect against such short circuits. Regular fuse block and fuses should, of course, be placed in the primary transformer circuits of 110 volts, etc., as usual.

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The electrolysis of water is a familiar example of the decomposing effect of the *direct* electric current. By the use of such a current water can be resolved into its component elements, hydrogen and oxygen. In order to do this the terminals of a direct electric current are inserted into a dish or glass containing the water. The positive terminal in known as the anode, and the negative as the cathode. When the current is turned on, it passes through the water from the positive to the negative terminal (from the anode to the cathode), and electrolyzes or decomposes the water. The most gas bubbles are given off at the negative electrode.

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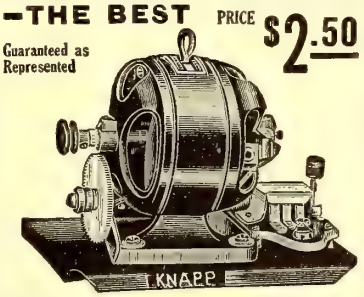
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A "WIRELESS" MENU.

The members of the Institute of Radio Engineers recently gave a dinner at New York City in honor of Mr. R. H. Marriott, United States radio inspector, who had his headquarters in New York City, but who was transferred to Seattle, Wash. The following "wireless" menu was served, and Dr. Alfred N. Goldsmith acted as toastmaster in the absence of Dr. John Stone, president of the Institute:

(Note: We are enjoined from serving courses at a frequency exceeding 250 per second.)

Automatic Starter to Order.
Rat-tail of Non-adjustable Bare Bluepoints for Bivalve Detectors.
Gumbo Electrolyte in Insulating Container of fixed capacity.
Portable Submarine Equipment in Dielectric.
Brush Dischargers. Oval Insulators.
Sans-Filet of Bass.
Podker Ultraudion Detector, Spud Type.
(Licensed for Use in Dining-room only.)
Vol-au-Vent of Jiggers, with Spherical Electrodes.
Fancy Sleet, with Plain Aerial.
Etherized Chicken, on Switchboard with Protective Devices.
Cohered Low Temperature Cream, with Spade Electrodes.
High Powered Cheese.
Radiation from Tree Antennae.
Ungrounded Coffee.
(Note: Saturation point should not be exceeded. Avoid examining tikker.)

COOPER HEWITT MERCURY OSCILLATOR.

(Continued from page 21.)

alternating current of any frequency, says *Electrical World*. Altho the rectifier is now said to be in such form that it may be used as a radio receiver of sensitiveness considerably greater than that of the most delicate electrolytic detectors, since the incoming energy is not only rectified but amplified, it is the oscillator which Dr. Hewitt believes to be of the greater commercial importance, both in radio signaling and in the transmission of power. At the present time the technical and physical details of the apparatus cannot be disclosed.

During the experimental study of various peculiar phenomena which occasionally accompany the operation of the mercury-arc rectifier, Dr. Hewitt encountered nearly a year ago an entirely novel set of conditions. Close investigation of these developed the fact that under certain circumstances the relations between current, voltage and resistance in the vapor conductor were of a kind absolutely outside the limits of his previous experience. Research into these curious effects resulted in the new oscillator, which, Dr. Hewitt states, is dependent upon electrical principles quite different from any hitherto used.

Not only is the physical basis of the invention a departure from earlier work, but the results already achieved have not previously been obtained through any other instruments. Even in its laboratory form, the oscillator has been found capable of producing, from direct current, sustained alternating currents of any frequency up to 100,000 or more cycles per second. The efficiency of conversion is excellent, and the low internal losses of the apparatus indicate that commercial use in numerous ways will be entirely feasible. In contrast to oscillators which have heretofore been suggested, the device is inherently capable of handling large amounts of power.

A characteristic of the device is that the frequency of oscillation may be

varied instantaneously over a wide range of values, which feature should increase the importance of the oscillator in its application to radio transmission. Similarly, the output in power may be altered easily and quickly, and through this property Dr. Hewitt anticipates that the apparatus will find extended use as a generator for radio-telephony. The instrument appears to be extremely rugged and to a large extent, self-protective when subjected to potentials much above the normal values used in operating.

Several distinct modes of operation are possible for the oscillator, and at the present time exhaustive researches, including oscillographic studies, are being made into the complicated electrical actions in the circuits of the apparatus. The correlation of these data now being obtained with the results of earlier investigations into gas and vapor conduction phenomena, should assist in the rapid growth of the new oscillator into a commercial machine. Dr. Hewitt has expressed the belief that after a reasonable period of development, such as was required to bring the mercury rectifier to its present forms, the oscillator should find extended practical use in many fields besides that of radio signaling.

AMATEUR WIRELESS PLANTS CLOSED BY GOVERNMENT.

Reports from a number of readers located in the western part of the United States, including the Philippines, indicate that close restrictions are being enforced by Government radio authorities in charge, regarding the operation of amateur wireless stations. As the majority of these stations, or at least those possessing sufficient power to cause any trouble, are all registered under the radio law now in effect, it does not seem fair to shut down every amateur radio station indiscriminately.

The radio amateur is entitled to as much attention as anyone else, and besides he is sworn to an oath of secrecy if he possesses a Government radio license.

We give below a letter from Mr. Walter Maynes, of San Francisco, which explains what we are driving at in part:

"In the Sixth Radio District, which embraces California, Utah, Nevada, Arizona and Hawaii, the radio amateurs have been refused permission to either send or receive ever since the war in Europe began. Rear Admiral Pond, of the Twelfth United States Naval Inspection Department, placed the ban on the wireless amateurs, much to their regret. The Sunset Radio Association, San Francisco, of which Walter Maynes, a licensed operator, is president, has taken the matter up, and is circulating petitions throughout the entire Sixth district for signatures of amateur operators, the intention being to present these petitions to Admiral Pond and induce him to lift the ban.

"The amateurs pledge themselves to a strict observance of the nation's neutrality, and hope to be placed on their honor, in the matter of sending and receiving. All operators in this district are eagerly availing themselves of the opportunity to sign the petitions and thus boost the good work. These petitions may be secured by addressing either Walter Maynes, president, 207 Hugo street, San Francisco; Carroll Reed, secretary, 1683 Seventh avenue, San Francisco, or Howard Lee, 1580 Grove street, San Francisco."

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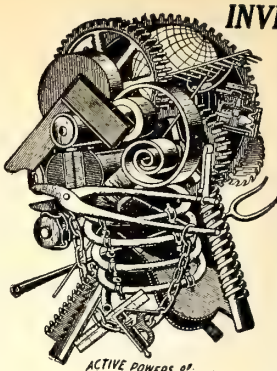
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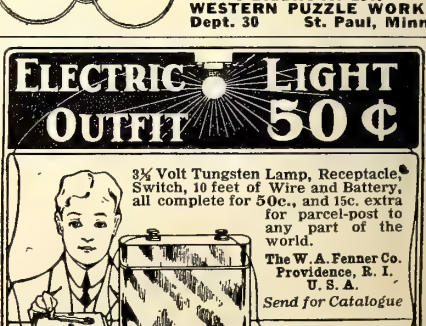
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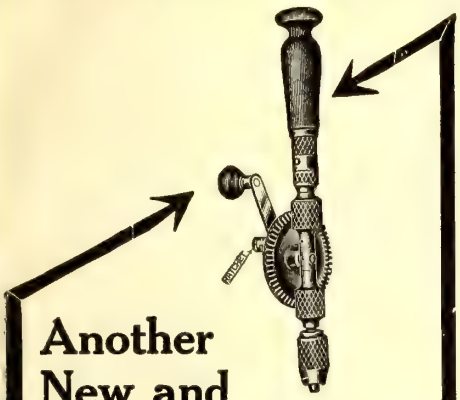
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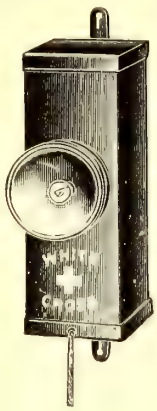
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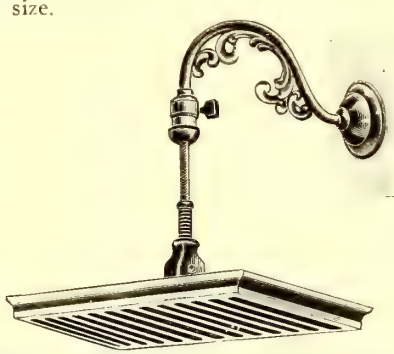
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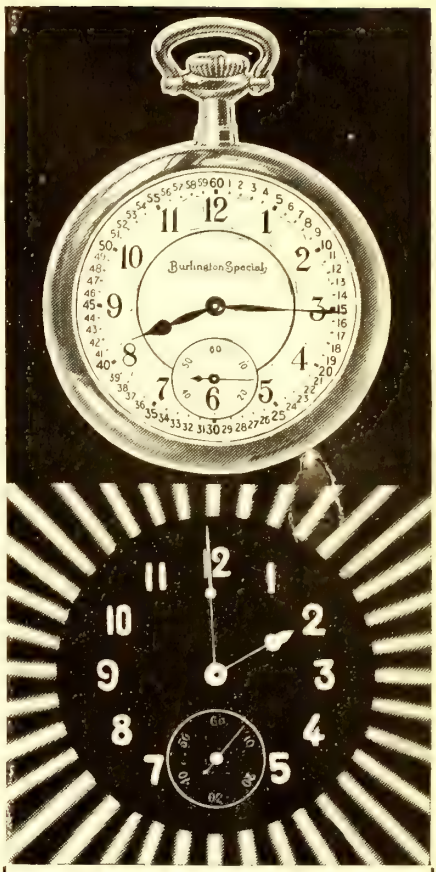
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BOOK REVIEW.

American Handbook for Electrical Engineers. Harold Pender, editor-in-chief., Prof. of Elec. Eng., University of Pennsylvania, formerly Director of Electrical Research, Mass. Inst. of Tech. Full morocco covers. 2050 pages, 7x4¼ inches. Gilt edged. Thoroughly illustrated. Price, $5.00 net. John Wiley & Sons, New York.

The book is a compilation of 260 articles upon the various branches of electrical engineering and allied engineering topics. The articles are arranged alphabetically with copious cross references. In addition, a detailed index occupying 60 pages is given at the end of the volume. The 26 authors of the articles are leaders in the engineering profession, and are well qualified to write upon their respective topics.

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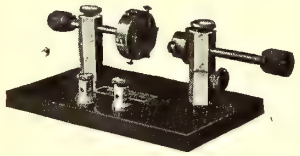
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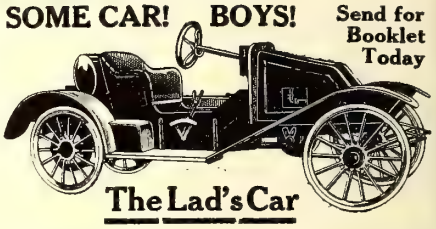


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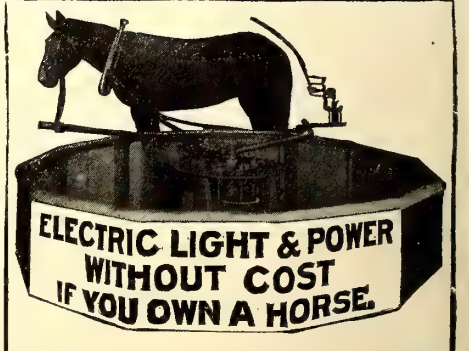
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1908 H. D. SINGLE with clutch and magneto, $30. 1910 H. D. battery model. A-1 condition, $35. 1911 H. D. single magneto model and clutch, $40. 1910 H. D. clutch and magneto, $45. 1 Indian motorcycle motor with magneto and Schebler carburetor, $25. 1 Excelsior motorcycle motor, $25. C. H. Lang, 1704 Michigan Ave., Chicago, Ill.

$50 TO $150 buys the best Motorcycles, every make and model in our large stock—must be cleared. Half price. Send for list to-day. Talking Machines, $5 and up. Brown Music Co., 9119 Commercial Ave., Chicago, Ill.

SEND for latest Bulletin of real Motorcycle Bargains, used and slightly used, all makes, models and prices; if you have $25 and really want a powerful Motorcycle, send for this Bulletin; hundreds of machines at all prices, new ones on easy payments; tell us what you want and how much you can pay; we can fix you up. Peerless Motorcycle Co., Dorchester, Mass.

USED Motorcycles, all makes, bargains. Send for list. Ward Bros., 212 Broadway, Camden, N. J.

OUR folder showing the new '15 Eagle 2-speed models is ready for mailing. Write for this and for the agency to-day. Sterling Motor Co., Brockton, Mass.

RIDERS: Write for our catalogue of motorcycle accessories and supplies. Andrews Specialty Co., 55 Warner St., Rochester, N. Y.

5-HORSE Pierce, single cylinder, magneto, Schebler carburetor, new tires, perfect running order, $125.00. Fred Gile, 50 Forest Ave., Portland, Maine.

GET copy of "Motor Cycle" published in England. Special War Issues received here weekly. Price 15c. Two for 25c. Distributors, 143 So. Wabasha, St. Paul, Minn.

* * * * * * * * * * * * *

Brooklyn, N. Y., April 15, 1915.

Gentlemen—The results obtained from my advertisement in the "Electrical Experimenter" really surprised me; in fact the demand for a certain instrument of mine exceeds the capacity for manufacturing and it is all through the "E. E." To date, 79 inquiries 12 orders. Might state last week filled a $50.00 *order netting me a profit of* $18.75. *As to the exact value of my orders to date, I prefer not to give figures; however, you will always see my ad. month in and month out. I can truthfully say that the "E. E." has it on them all, viz., for quick results, interesting reading matter, etc. Very truly yours,*

HARRY Y. HIGGS.

* * * * * * * * * * * * *

MOTORCYCLES, all makes, rebuilt, guaranteed good as new. Indians, Harleys, Excelsiors, Readings, Kulteres, Merkels, single and twins, $25 to $100. Buy direct, save dealers' profits. Deninger Cycle Co., Rochester, N. Y.

DON'T buy a Bicycle Motor Attachment until you get our catalogue and prices. Shaw Mfg. Co., Dept. 27, Galesburg, Kan.

YALE, Pope, Thor, bargains. Late models. Walter Munger, Excelsior, Minn.

FORMULAS

LATEST FAD. The celebrated everlasting fragrant rose beads can be easily made and sold with big profit. Strings sell as high as $3.50 to $5.00. Formula with full instructions for making same, 25 cents coin. J. C. Regan, 1162 Broadway, New York.

IS the formula you want worth a quarter? State exact requirements. Raymond, Roosevelt, N. Y.

1,000 TRADE secrets and formulas, 25c. 500 selected formulas, 20c. Resilver mirrors, guaranteed process, 20c. Make Sneezing Powder and Itch Powder, 10c. each. Entire lot, 50c. Service Bureau, 3111-T, Belleplaine Ave., Chicago.

MAKE Candy evenings; pays; receipt, 10c. Elmer Zimmerman, 1435 Walnut, Harrisburg, Pa.

START factory making candies, gums, crackerjack, orangeade, ciders, etc. Sells fast. Nearly all profit. $15 course $1.00. Catalog, 2c. Robert Hamilton, Barnes City, La.

SIX Valuable formulas for sympathetic inks, 50c. Wayne Thomas, Ithaca, N. Y.

FORMULAS for inks, black, blue, red, gold, green, silver, indelible, 15c each. 7 for $1.00. Stephen Rafferty, 2122 Arch St., Philadelphia, Pa.

PHOTOGRAPHIC

WE buy, sell and exchange. Bargains in Microscopes, Telescopes, Binoculars, Cameras, etc. Bargain list sent. Kahn & Son, Opticians, No. 54 John St., New York. Established 62 years.

SPOT Cash paid for high-grade Kodaks, Lenses and Cameras. Send full description, stating lowest price. Cameras exchanged. In business since 1885. David Stern Co., Dept. M, 1047 W. Madison St., Chicago.

FILMS developed, 10c., all sizes. Prints 2¼x3¼, 3c.; 2½x4¼, 3½x3½, 3¼x4¼, 4c.; Post Cards, 50c doz. Work guaranteed and returned 24 hours after receiving. Postpaid. Send negatives for samples. Girard's Commercial Photo Shop, Holyoke, Mass.

ROLL Films developed 10c. per roll. Printing Post Cards, 3c. each. 15 years' experience. Give me a trial. You will be pleased. F. C. Hoyt, Sac City, Ia.

EXPERT Kodak Finishing! Send for price list. Electric Studio, 162 Stephenson St., Freeport, Ill.

KODAK films developed. 5c., all sizes. Prints, 3c. each, any size. P. Johnson, 100 W. Bridge St., Oswego, N. Y.

TRANSFER pictures to china, etc.; no formulas; particulars. Flinn, 286 West 142nd St., New York City.

THINK OF IT! Only $20 for finest German Double Anastigmat in Ibso shutter, for 3A Kodaks and postal card cameras. Send for matter describing best Lenses on earth at way down prices. Lafbury Co., 305 North Fifth Ave., Chicago.

FILMS developed 10c., all sizes, prints 2¼x3¼, 3c.; 2½x4¼, 3½x3½, 3¼x4¼, 4c.; Post Cards, 50c. dozen. Work guaranteed and returned 24 hours after receiving. Postpaid. Send negatives for samples. Girard's Commercial Photo Shop, Holyoke, Mass.

$54 CENTURY Grand, bargain, $25. Magnificent Ensign Reflex, Zeiss Triotar Anastigmat, complete, $65. $22.50 Autographic Kodaks, $19.75. Slipin Calender Mounts, assortment, $1. Catalogues mailed. Newark Photo Supply Co., Newark, New Jersey.

HEADQUARTERS for selling or exchanging Cameras of all kinds. Carry a full line latest Kodaks. Graflex. Premos, foreign Cameras. Write for big bargain list. Gloeckner & Newby Co., 171 Broadway, New York.

KODAK Films Developed, 10c. per roll, any size. Prompt attention given mail orders. Prints, 2¼x3¼ to 3¼x4¼, 3c.; 4x5 to 3¼x5½, 4c. J. M. Manning, Box B, 1062 Third Ave., New York City.

PRINTING

POSTPAID—1,000 envelope slips, 75c.; 500 two-color bond letterheads, or envelopes, $1.00. Samples free. The Ryder Print Shop, Dept. M6, Barnerville, N. Y.

PREPAID, Printing (600 miles) 1,000 bond letter heads, $2.39; envelopes, $2.14; return envelopes, $1.77; imitation typewritten letters, 150 words, $1.73; 300 words, $2.64; 6x9 circulars, $1.75; art ad slips, $1.00. Ask for prepaid prices on any printing. Good's Quick Print, Harrisonburg, Va.

MAGIC AND TRICKS

MAGIC pocket trick free. Worth 25c. With illustrated catalog of 250 tricks, puzzles, illusions, for 6c. Stamps. Magic Co., Sta. 10, 249 West 38th St., New York.

POST Cards, Tricks and Jokes, Coins, Notes, Stamps and curious things. Catalog for stamp. Coin Exchange, New Rochelle, N. Y.

BIG Catalogue. Magic, Entertainment goods free. Bates Co., Melrose, Mass.

MAGIC Tricks, Jokes and Puzzles. Trick with my catalogue, 10c. coin. H. V. Dils, Huntington, W. Va.

GREAT book wonders, secrets and mysteries and novelty catalogues, 10c. Wright Spec. Co. (D), Brewster, N. Y.

MAGIC tricks for the profession. Big catalogue and pocket trick free. Ventriloquial figures, $6.00 up. Magic Parlors, 192 Clifford, Providence, R. I.

NOVELTIES, Books, Tricks, Games, Etc. Illustrated catalogue free. Sample 25c. card trick, 10c. Auburn Supply Co., Specialty Dept., 7745 Peoria St., Chicago.

SECRO-WRITO; New System of secret writing. Keeps your correspondence safe and private. Strangers cannot read your cards and letters. Great fun for everybody. Samples and instructions, 10c. H. J. Teeple, Decatur, Indiana.

GREENBACKS—Yellowbacks, Stage money. New kind, 10c. bunch; 4—25c. Eureka Supply, P29, 3827 N. Kenneth, Chicago.

250 MAGIC Tricks with cards, coins, etc., 10c. Greenbacks, big wad, 10c. Novelty Shop, 3311-T, Belleplaine Ave., Chicago.

GREENBACKS—Big wad, 10c. 4—25c. Enterprise Co., 1003-PM, Morton Bldg., Chicago.

MAGIC Bargain Sheet and Catalog 2c. Gilnovco, Morgan Park, Ill.

GIVE 'em the "creeps" with the Mysterious Skull. Shines, without any light, in the dark. Really wonderful, 10c. Bartlett, Box 960, Milwaukee.

FAKE Money—Big, flashy roll, 10c. Gilnovco, Morgan Park, Ill.

MAGIC disappearing coin and ring trick, mystifies, amuses. Send 10c. in coin. Catalog. Powell Sales Co., Dept. E., Ossining, N. Y.

BE a Magician. Travel. Give shows; earn money. I tell how. Send stamp. Prof. Rapp, Box F1115, Madison, Wis.

BE a handcuff king. We teach you. Escape from handcuffs, boxes, ropes, etc. Secrets of 20 sensational escapes, $1. Particulars free. The Magicraft Co., Dept. A, Box 251, Detroit, Mich.

TRICKS, puzzles, jokes, cards, dice, ventriloquist figures, magic goods, sensational escapes and illusions. Big catalogue free. Oaks Magic Co., Dept. 180, Oshkosh, Wis.

MODELS

MODELS made for inventors; general machine work; designing and perfecting; developing automatic devices and machinery; in a position to do all kinds of light tool and machine work. Prices reasonable; estimates cheerfully given. Ideal Machine Works, 62 Ann Street, New York City.

INVENTORS: We manufacture metal articles of all kinds to order. Also special machinery, tools and dies; punchings, lathe and screw machine work, metal spinnings, castings, plating, wood and metal patterns, etc. Send sample for estimate and expert advice, free. The Eagle Mfg. Co., Dept. B, Cincinnati, Ohio.

I MAKE models for inventors and guarantee first-class workmanship; also do repair work and light manufacturing. George Wood, 223 Postal Telegraph Bldg., Kansas City, Mo.

PRODUCERS of Results; Inventions Developed, Light Mfg., Models, Experimental Work, Tools, Dies and Stampings. Johns Machine & Stamping Works, Middle Bldg., Dept. C, Cleveland, Ohio.

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WE make working models for inventors; also dies and stamping of specialties, and carry a complete stock of brass gears and model supplies. Send for catalogue. The Pierce Model Works, 3405 Pierce Ave., Chicago, Ill.

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STAMP Album with 538 Genuine Stamps, incl. Rhodesia, Congo (tiger), China (dragon), Tasmania (landscape), Jamaica (waterfalls), etc., 10c. 100 diff. Jap., N. Zld. etc., 5c. Big list; coupons, etc. Free. We buy stamps. Hussman Stamp Co., St. Louis, Mo.

GET the most out of your money you can. Try my 1, 2 and 3-cent approvals and you'll be pleased. References required. Wm. Haase, 971 E. 39th St., Los Angeles, Cal.

STAMPS—100, all different, free. Postage 2c. Mention paper. Quaker Stamp Co., Toledo, O.

FOREIGN Stamps Free, 52 different foreign, including China and Venezuela, to all who apply for our high grade approval selections. Send two cent stamp for return postage. Edgewood Stamp Co., Dept. H, Milford, Conn.

$4.25 EACH paid for U. S. Flying Eagle cents dated 1856. Hundreds of other U. S. and foreign coins wanted. Send 10 cents at once for new illustrated coin value book, 4x7. It may mean your good fortune. Clarke Coin Co., Box 94, Le Roy, N. Y.

MISCELLANEOUS

ENGINE LATHE, swings 9½ in., takes 25 in. between centers. Complete set gears, cutting all size threads, 3-in. to 40-in., $43.50. Grammes & Sons, Allentown, Pa.

AGENTS—Big money in perfumes, toilet articles, etc., make them yourself—we show you how. Mixers Supply Company, Poughkeepsie, N. Y.

GASOLINE Engine Castings, with drawings, cheap. Catalog for stamp. Novelty Manufacturing Co., 853 West 6th St., Cincinnati, Ohio.

SILVER Plating Tablets. Old brass or copper, spoons, watches, etc., can be instantly plated silver in a beautiful manner with the silver plating tablets. Sample tablet, 10c. Agents wanted. Utility Co., Cardston, Alberta, Canada.

100 IMITATION Elks' Teeth, guaranteed very fine, $2 each. H. Beddow, 2156 8th West, Seattle, Wash.

THREADED BRASS ROD, 8-32, 15c. foot. N. Lowry, 22 Wyoming St., Carbondale, Pa.

COLUMBIA Grafanola and eight records used one week, $20. Typewriter, two-color ribbon, back spacer, tabulator, etc., $30. Full particulars. Frank Cowles, Canton, Conn.

FATHERS, MOTHERS! Let your son learn a clean, high-class, educational trade that pays $1,200 yearly. Mastered day or evening. Unlimited course (usually takes three to five months), $150. Short courses also. Please call or write for particulars. EMPIRE MERGENTHALER LINOTYPE SCHOOL, 419 First Avenue, New York City.

RAISE Guinea Pigs — Great demand, thousands used yearly, more profitable than poultry or squabs. Easy to raise. I buy all you raise. Market assured. Please enclose stamp for full particulars. Edward F. Tobener, 2828 Woodland Ave., Kansas City, Mo.

FIELD-Marine Day and Night Glasses with case, 25-mile adjustment, $30.00 value, only $6.50. Money back if not satisfied. Ye Curiosity Shop, 20 S. Second St., Philadelphia, Pa.

YOUR PHOTO on a pillow top or handkerchief on high class material, Swaboda Satin; washable, will not fade. Pillow top in any one of 6 colors, namely: white, blue, green, lavender, pink or yellow. Prepaid to you, only $1; 6 for $5. Satisfaction guaranteed or money refunded. Rogers Supply Co., 4435 Washington Blvd., Chicago, Ill.

MAIL ORDER OPPORTUNITIES

EVERYTHING in the mail order line; state your wants and we will do the rest. Pacific Specialties Co., Los Angeles, Cal.

EUROPEAN War Map and chances to start a profitable business of your own, 10c. C. S. Mathews, 69 East 87th St., Portland, Ore.

WE will start you in the cleaning and dyeing business. Little capital needed. Big profits. Write for booklet. Ben Vonde System, Dept. A-K, Charlotte, N. C.

MAIL Order Men. Would you like to know how 61 successful mail order men do business? Especially if these men tell you their own experience in their own words. The Mail Order Business Builder gives you such information direct from these men's private offices from month to month. Send dime for sample copy of this 66-page magazine. Randolph Rose, Publisher, No. 8 Broad St., Chattanooga, Tenn.

WIRELESS

FREE—A beautiful Wireless Receiving Set enabling you to receive messages 300 miles, for selling only 25 boxes of my Spot Remover. Sells on sight. Be one of the first in your town to own a Wireless Set. Write now. Marge Co., 702 N. 6th St., East St. Louis, Ill. Dept. K.

GALENA DETECTOR, 2x2x2¼ in., shipped prepaid on receipt of 60c.; vulcanized base, heavy standard, large nickeled binding posts; excellent working instrument, and of neat appearance. The kind of instrument you have been wanting. Carl Rhapstock, Plainfield, Wis.

DETECTORS, tuning coils, condensers; everything in the wireless line. Bargains in all kinds of apparatus. Write M. Paul, 134 Dewey Ave., Jamaica, L. I.

"WIRELESS CHART" giving capacity, wave length, inductance, etc., values directly. Why wade through complicated formulas? "Chart," prepaid, 20 cents. Send stamp for list of labor saving charts. H. Secor, Consulting Engineer, 2040 7th Ave., New York City.

AMATEURS! Exceptional radio apparatus; my type "A" special amateur tuner, a guaranteed interference preventer, tunes up to 1,500 meters. Price $6.00. Send 2c. stamp for catalogue. H. Y. Higgs, 30 Irving Pl., Brooklyn, N. Y.

Scientific Exchange Columns

UNDOUBTEDLY you have at the present time some things for which you have no further use. Do you wish to sell these things or exchange them for something, for which you have immediate use? There is no surer and quicker way to do this than by advertising your articles in these columns. The **Very** people, the **Only** people, who could possibly have a use for your things read this journal. More than 30,000 interested people will see your ad. It is furthermore the cheapest advertising medium for you in the country.

The rates are: One cent per word (name and address to be counted) minimum space 3 lines. Count about 7 words to the line. **Remittance must accompany all orders.**

We reserve to ourselves the right to refuse any advertisement which we consider misleading or objectionable. Advertisements for the June issue should reach us not later than May 10th.

The Classified Columns of "The Electrical Experimenter" Bring Positive Results.

WILL SELL "Edison—His Life and Inventions," 2 vols., 990 pages, illustrated, cost $4.00; 4-ohm key and sounder, 6-v. 4-c. electric bulb and socket, Dodge's "Telegraph Instructor," all for $4.00. Mark Kistler, Centreport, Pa.

WANTED, TO SWAP—Good 5x7 view camera with F6 symmetrical lens and tripod and carrying case; practically new. Will trade for good wireless set. Carl Caufield, Niles, O.

HAVE a new camera and outfit; also a new mandolin, guitar, cellaphone. Will trade for phonograph, typewriter or electrical apparatus. Ralph Thouson, Towner, N. D.

WILL SELL new omnigraph, cost $9.00, for $5.00. John Tuger, 668 Park Ave., Brooklyn, N. Y.

FOR SALE OR EXCHANGE—Rotary gap, electrolytic detector, some No. 4 copper wire and several pieces of detector mineral. I would be pleased to exchange photos of radio set. Address Cecil Bridges, Louisville, Ill.

FOR EXCHANGE—Large factory-made receiving transformer, Morse inking register with rolls of tape, for disc talking machine or offers. H. Butterworth, 15 Kosciuske St., Brooklyn, N. Y.

WILL EXCHANGE 250 ft. motion picture film for good loading coil. Chaafie, 103 Prospect Ave., Hackensack, N. J.

FOR SALE OR EXCHANGE—Wireless goods. Send for descriptive circular. Address Merle Y. Hodgkins, 42 Wellington St., Waltham, Mass.

TO SELL—Knapp type "S" dynamo motor, 9-volt, 3,000 rev.; perfect condition, except pulley. Cash $4.00. Will run sewing machine, etc. Merrill Palmerton, Collins Center, Erie Co., N. Y.

FOR SALE—One 2,000-ohm head set with split headband, one 22-calibre Savage rifle, one Voltamp Marvel dynamo motor and one No. 2 Brownie camera; all in first class condition. W. B. Main, Calais, Me.

FOR SALE—One Electro, Jr., loose coupler, one nine-plate variable condenser, one electrolytic detector, one pair Electro 2,000-ohm phones; all good as new. Carl Mathiasen, Onawa, Ia

FOR SALE OR EXCHANGE—Half horsepower two-cycle gasoline engine, "Auto Sparker" dynamo, telescope, bicycle lamp (gas), books, magazines. Want microscope, camera, storage battery, or what have you in the electric line? John Wells, Moosomin, Sask., Can.

WILL SELL my sending and receiving outfit, aerial, insulators, etc. Write and state what you need. Phil Schmitt, 1337 Third Ave., New York, N. Y.

FOR SALE—1½-in. spark coil, helix, antenna, switch, Junior fixed condenser, 4-bar generator, No. 14 aluminum aerial wire and 20 good switches. Vernice Sell, 514 N. Webb Ave., Alliance, O.

FOR SALE—½ K. W. open-core transformer, $5.00; glass-plate condenser, 10 plates, 6½x8½, $1.50; electrolytic interrupter, $1.50; good, heavy spark gaps, $0.75; key with leg screws, $0.75, and a helix, $0.75. All in good condition. $10 takes entire lot. Philip M. Foote, 146 E. Frambes Ave., Columbus, O.

FOR SALE—$150.00 worth of wireless and electrical goods, and Berry's "Horsemanship Course" in 8 books, cost $15.00; or will exchange for stamp dealer's outfit or typewriter. Albert L. Hoydar, Fairfield, Neb.

WILL SELL polarized relay, coherer, tape register, fix and rotary condensers, Ferron detector and E. I. vario selective coupler (Mignon); also film-developing tank. Max Kuhne, 94 River St., Hoboken, N. J.

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Complete
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Absolutely high grade real wireless receivers, equal in sensitiveness, quality of materials, and dependability to any obtainable anywhere at many times the price.

We will, upon receipt of price, deliver a Murdock Special set, with the privilege of fourteen days trial. If for any reason the purchaser is dissatisfied, either with the receivers or our claims, the purchase price will be immediately refunded upon return of receivers.

SEND FOR CIRCULAR GIVING FULL DESCRIPTION OF THIS NEW HEAD SET

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FREE Ten text-books, handsomely bound, printed in large, clear type on fine quality of paper and profusely illustrated, are furnished **free** with this course.

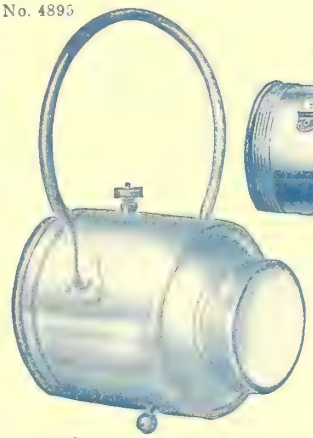
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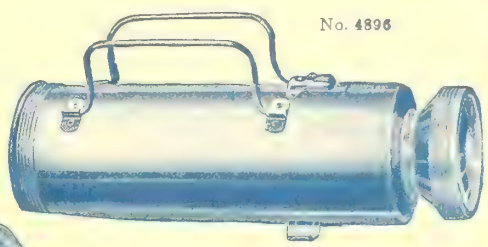
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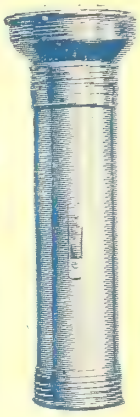
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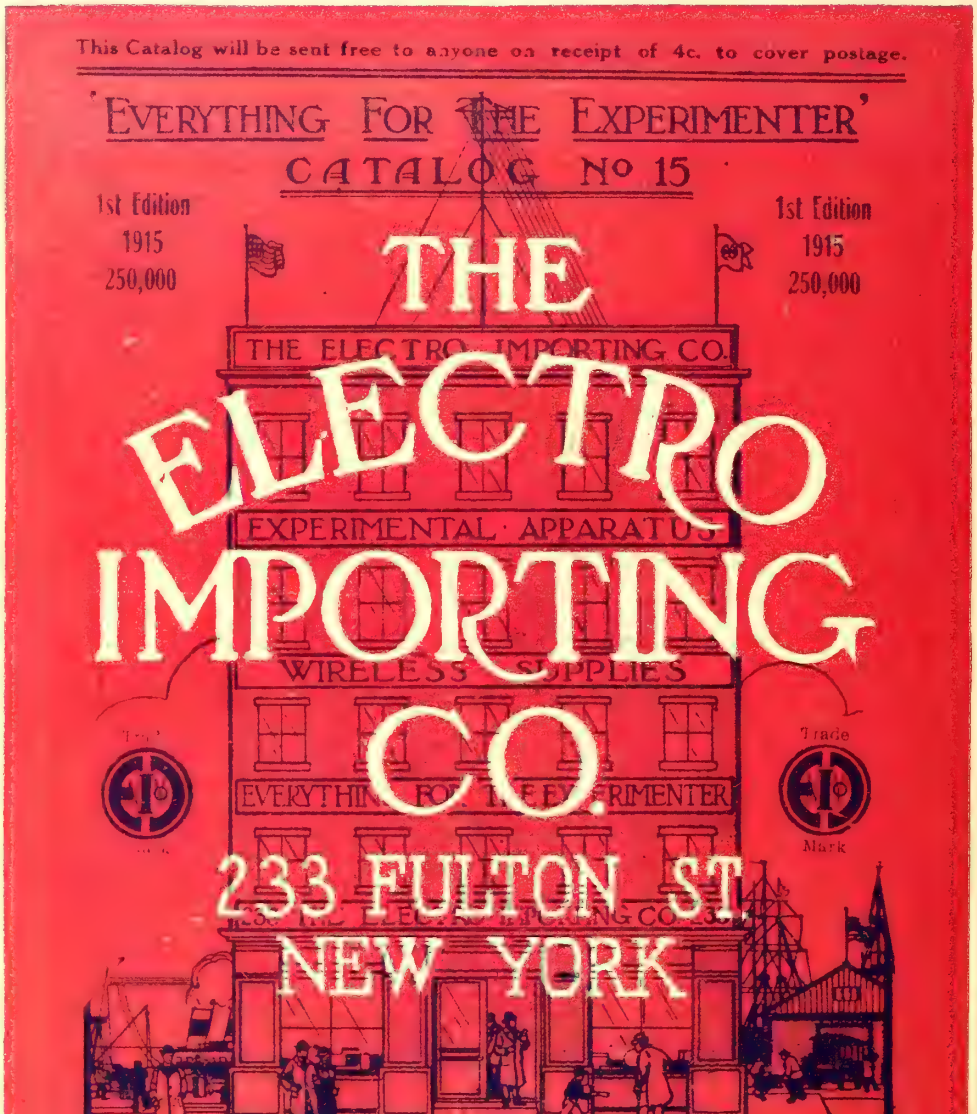
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The Wireless Law of August 13, 1913.
How to Receive Wireless Messages.
How Far You Can Telephone by Wireless.
Wave Lengths of Principal Radio Stations.
How to Erect a Wireless Aerial.
How to Receive Time by Wireless.
How to Photograph Electrical Discharges.
How to Experiment with Spark Coils.
How to Test Storage Batteries.
How to Make Tesla's Experiments.
Call Letters of all Commercial and Government Wireless Stations.

TRADE MARK.

How to Calculate Radio Wave Lengths.
What Is Ohm's Law?
Resistances of Different Metals.
Capacity of a Condenser.
How Far a Spark Coil Will Send.
What Size Wire Receivers Are Wound with.
How Receivers Are Made.
How to Charge a Storage Battery with A. C. Current.
How to Produce a 3-Inch Spark Without Batteries, Coils or Current.
How to Solder Aluminum.
What Is a Joule?
How Many Grammes in a Drachme, etc., etc.



In addition to the goods listed in our catalog No. 14, our new Cyclopedia Catalog No. 15 contains: Baseball, Football, Basketball and Tennis Supplies, Photographic Supplies, Watches, Knives, Microscopes, Telescopes, Printing Presses, Steam Engines, Batteries, Flashlights, Lighting Plants, Power Motors, Generators, Rotary Converters, Wireless Apparatus and Supplies, Immense Scientific Book Section, etc.

Cyclopedia Catalog No. 15 is 5x6¾ inches in size, contains 272 pages and 658 illustrations, complete code chart and diagrams, and has many pages devoted to interesting and instructive Tables, Treatise on Wireless, Telegraphy and valuable rules, laws and formulas, etc.

TRADE MARK.

You will find that we do not list anything and everything in our catalog. An article to be handled by us must have quality, strength, durability and a reasonable price. To insure its doing just what we claim, every article undergoes a series of hard tests—Result, however, is we can unhesitatingly guarantee every article sold by us.

Therefore—if you don't see an article in our catalog you probably know that there must be good reasons why it isn't there.

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I enclose herewith 4 cents in stamps or coin for which please send me your latest Cyclopedia Catalog No. 15 containing 272 pages, 658 illustrations and diagrams including Treatise on Wireless Telegraphy, complete list of all U. S. Wireless Call Letters, and 20 coupons for your 160 page Free Wireless Course in 20 lessons.

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"The Livest Catalog in America"

THE ELECTRO IMPORTING COMPANY

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"Everything for the Experimenter"

THE ELECTRICAL EXPERIMENTER

JUNE 1915



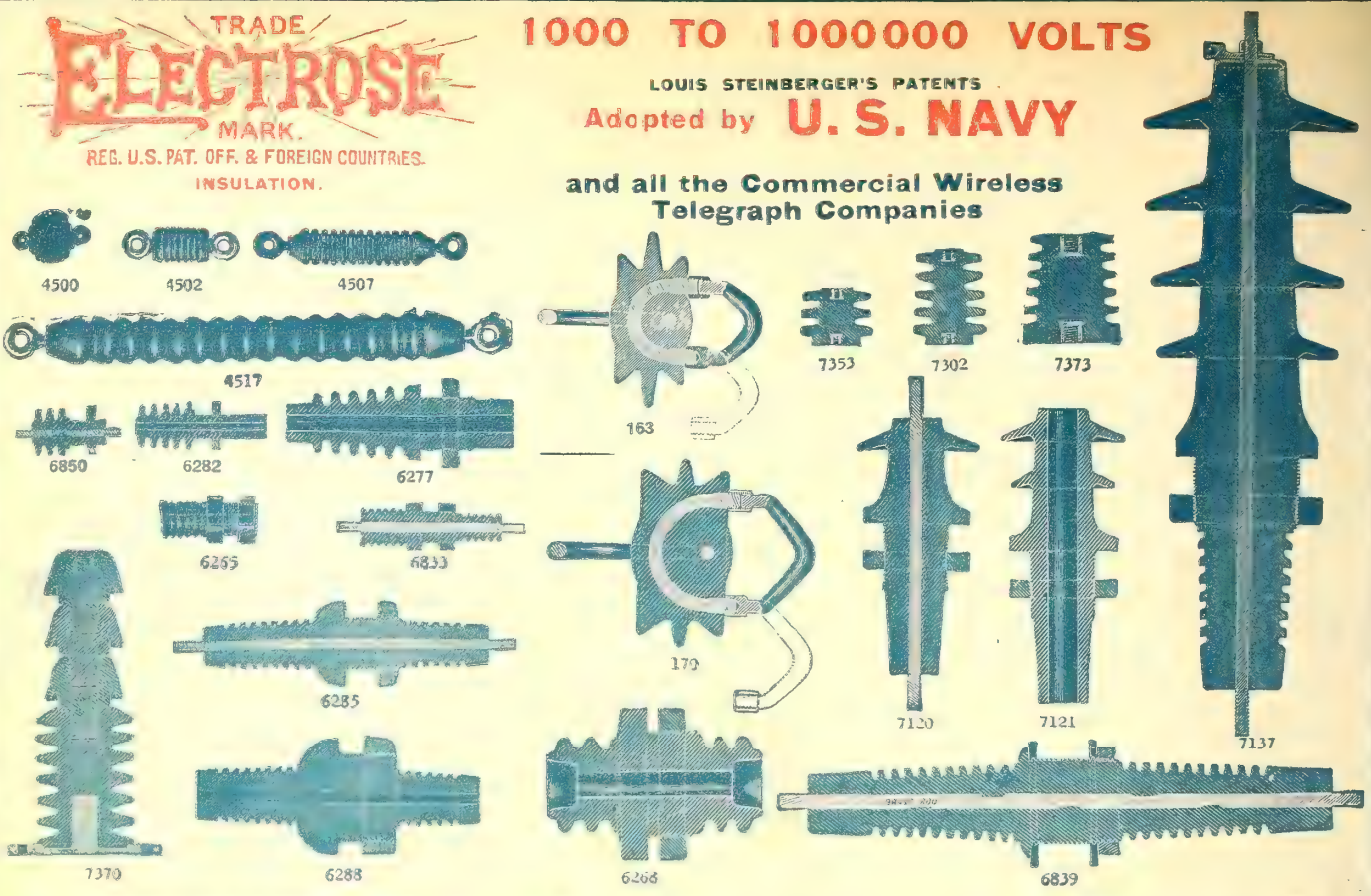
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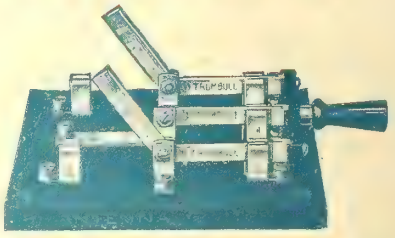
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The Electrical Experimenter

Vol. III Whole No. 26 CONTENTS FOR JUNE, 1915 No. 2

TALKING MOTION PICTURES AND SELENIUM By Samuel Wein 35
THE EDISON LABORATORY AND THE BRAINS BEHIND IT 36
THE ELECTRO MAGNET, PAST AND PRESENT. 36
THE ROLE OF ELECTRICITY IN FILM PLAYS By H. Winfield Secor 37
THE WORK OF THE ELECTRICAL TESTING LABORATORIES 38
CATCHING FLIES BY ELECTRICITY..... 38
AN INTERVIEW WITH NIKOLA TESLA..... By Samuel Cohen 39
BARON MÜNCHHAUSEN'S NEW SCIENTIFIC ADVENTURES .....By Hugo Gernsback 40
AN ELECTRIC DOG THAT FOLLOWS LIGHT RAY 43
"THE WHITE FEATHER" OR WIRELESS IN STAGE-CRAFT 44
ELECTRICITY IN PLANT LIFE..... 44
THE TOWER OF JEWELS AT 'FRISCO EXPOSITION 45
ELECTRIC LIGHT FROM WIND-MILLS..... 46
ELECTRICITY AND THE WAR..... By Frederich Waldersee, Berlin 47
OBSERVATION CAR ELECTRIC SEARCHLIGHT 48
ELECTRIC FISHES 49
THE GRIPENBERG SELENIUM CELL..... By Samuel Wein 50
HOW TO COMPUTE YOUR ELECTRIC BILL.... 50
HOW TO BUILD A TELEGRAPHONE..... 51
WIRELESS ON THE MOTOR BOAT..... 52
AN INKLESS TELEGRAPH RECORDER..... 53
SPECTACULAR DISCHARGES AND LARGE TESLA COILS 54
WRINKLES, RECIPES AND FORMULAS..... Edited by S. Gernsback 56
A REMARKABLE PRIMARY BATTERY..... 56
THE FESSENDEN RADIO STATION AT BROOKLYN, N. Y..... 57
100 K. W. POULSEN ARC..... 57
WIRELESS IN THE POLICE BARRACKS..... 58
VARIATION OF STRENGTH OF RADIO SIGNALS 59
THE D. C. ARC FOR WIRELESS TELEGRAPHY AND TELEPHONY (Conclusion)..... 62
ELECTRICAL MAGAZINE REVIEW..... 66
LATEST PATENT DIGEST..... 67
"AMONG THE AMATEURS" DEPARTMENT.....68-69
"QUESTION AND ANSWER" DEPARTMENT..... 70

With the Editor

WE believe that you will like this number of *The Electrical Experimenter*. As will be noted, the size has been increased again, from 32 to 48 pages, a 50% increase of text matter. No expense has been spared toward making this issue as perfect as we know how and you will agree with us that it is a big improvement over former numbers.

You will find feature articles in the June number which you cannot find in any other magazine. Our readers have come to know *The Electrical Experimenter* for publishing new and important things electrical, ahead of any other magazine, and we believe that you will agree with us that the manner in which we present the various articles now cannot be much improved upon.

Unquestionably this magazine to-day is the greatest electrical 10c. worth in the country; its 48 large pages represent 96 pages of the ordinary magazine size. The June number with its 123 illustrations and its 109 articles, excels a great many 15c. publications.

Nevertheless, we are far from satisfied; it is our ambition to regularly publish a magazine above 100 pages at 10c. a copy. Will you help us in our task?

First, we must satisfy you by knowing just what you would like us to publish. Our voting blank, which we print elsewhere, helps you to decide quickly; we urge you strongly to use it, as it will be an important factor toward making the magazine after your own heart.

Second, if you like this magazine tell your friends about it, or, still better, when you send in the voting blank, write the names of a few friends interested in electricity on the reverse side. We will promptly send them sample copies with our compliments.

The July issue will have some very important articles and you will also find in it some new intensely interesting departments which we know you will welcome.

Beginning with the August issue we have a nice surprise awaiting you; WATCH FOR IT!

Last, but not least, remember that the advertisers of this magazine make it possible for us to publish *The Electrical Experimenter*. Without their support we could never increase the size nor give you the articles as we do now. Considering this, the advertiser has a right to expect your patronage; he deserves the same consideration as the publishers; as a matter of fact, more so. For this reason you should send for the advertisers' literature, catalogs, etc., and you will find that it pays you to do so. Many of the catalogs and circulars advertised contain valuable information, not usually found in text-books. If you are interested in this magazine, you cannot possibly fail to be interested in our advertisers' literature as well as their products. THE PUBLISHERS.

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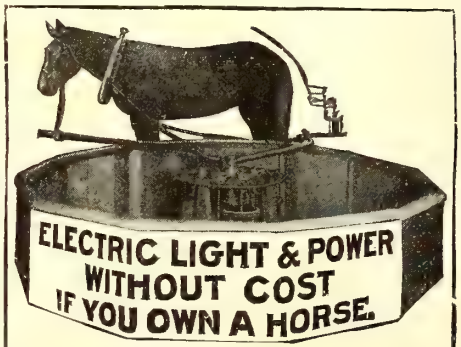
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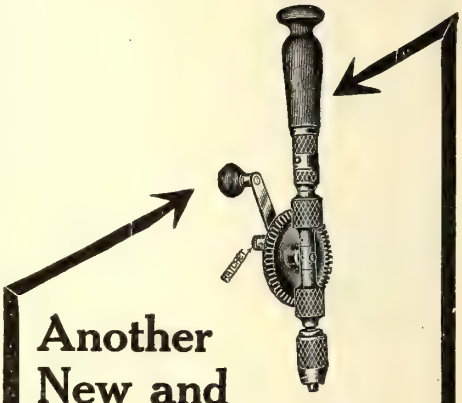
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Vol. III. Whole No. 26 JUNE, 1915 Number 2

Talking Motion Pictures and Selenium

By Samuel Wein

IN the present-day talking motion picture systems, use is made of simultaneously recording and reproducing animated objects and sounds, by means of combining the motion picture machine and the phonograph. The success attained thereby is of very little practical importance, owing to the difficulty of ensuring perfect synchronism. Another method recently patented was to record the sound waves from the needle of the phonographic "sound box" on the same film with the motion pictures; the success attained in this method is of no value at all on account of the fact that duplicates were impossible to make and not only that, but that the film in order to reproduce the sounds therefrom must be a little thicker than what it is; otherwise the sounds will not be reproduced successfully.

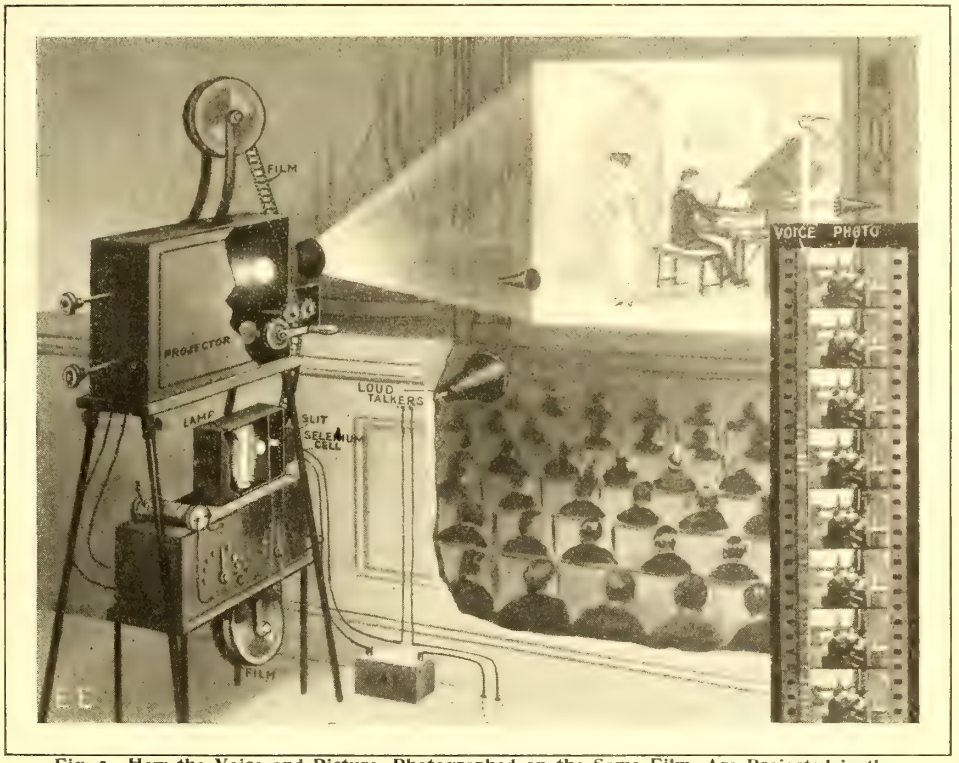


Fig. 2. How the Voice and Picture, Photographed on the Same Film, Are Projected in the Theater. At Right: Strip of Double Record Film.

It is essential to the correct reproduction of the movements of the persons or objects in combination with the sound waves, that the simultaneous movements and sounds should be recorded and reproduced simultaneously in exact synchronism and that the sound waves which constitute the sounds should not suffer any variation in the process of recording and reproduction, but should be recorded and reproduced without the introduction or accompaniment of any other sound waves.

It is obvious, therefore, that no true record or reproduction of the sound waves could be made by any mechanical process or means in which a hard substance necessary to make the impression comes in contact with another hard substance, such for instance as the recording or reproducing pin of the phonograph, because the friction caused between the two hard substances itself creates vibration or sound waves which accompany, vary or modify, the sound waves which it is desired to record and reproduce. These are recorded and reproduced with the latter, proving detrimental to their true acoustic reproduction. The record, therefore, must be taken or produced without any contact between the medium caused to vibrate by the sound waves and the record or recording substance. It is further obvious that if the impressions of the movements and sounds were recorded separately on separate records, the movements and sounds would be liable to vary in point of time and fail to synchronize with each other.

Another disadvantage of the present day talking motion picture machines or systems is that if the operator either neglectfully or wilfully tears or cuts out a piece of the film which constitutes the movements or actions, the result would be that a certain amount of action or movement is missing, but, the equivalent in sounds would still be in the phonographic record, thus showing the device would soon be put out of synchronism at this point.

In order to avoid this and to insure correct synchronism the late Dr. Ernest Ruhmer of Germany (see *Scientific American*, July 20, 1901) already in 1901, in his experiments with the "photographophone," was the first to suggest that the "movements and sounds must be recorded (photographically) simultaneously, on the same photographic film."

For the purpose of collecting or receiving the sound waves, a sensitive telephone transmitter is employed to transmit the sound waves electrically (in the usual manner) from the place where the sounds originate to the motion picture camera; which has a source of light so arranged that it will vary in degrees as to area, quantity, intensity and corresponding effect of light and shade, proportioned to their period and amplitude, simultaneously with the recording photographically of the successive movements of the objects on the same film, as outlined in Fig. 1. Fig. 2 shows voice waves thus photographed on the strip of film alongside of the picture space.

When such a film record is obtained, it is reproduced by causing light to pass through that portion of the film contain-

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All communications and contributions to this journal should be addressed to: Editor, **THE ELECTRICAL EXPERIMENTER**, 233 Fulton Street, New York. Unaccepted contributions cannot be returned unless full return postage has been included. ALL accepted contributions are paid for on publication. A special rate is paid for novel experiments; good photographs accompanying them are highly desirable.

THE ELECTRICAL EXPERIMENTER. Monthly. Entered as second-class matter at the New York Post Office, March 1, 1915, under Act of Congress of March 3, 1879. Title registered U. S. Patent Office. Copyright, 1915, by E. P. Co., Inc., New York. **The contents of this magazine are copyrighted and must not be reproduced without giving full credit to the publication.**

ing the picture record of the successive movements, and so project them on to a screen, and also simultaneously cause light to pass through that portion of the film,

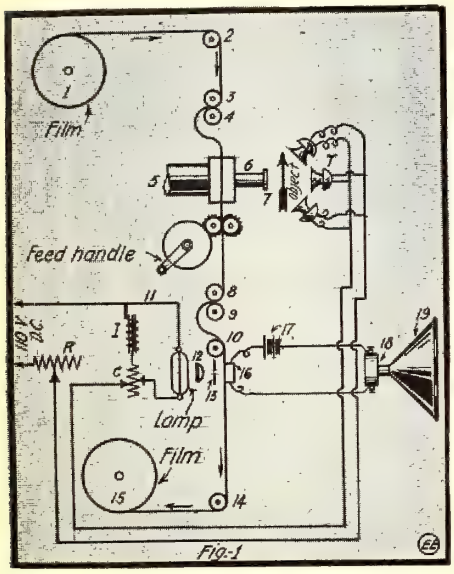


Fig. 1. Schematic Layout of Talking Picture Arrangement.

containing the *photographic sound record,* and thence onto a selenium cell, which is connected in series with a battery and a loud speaking telephone receiver.

In the diagram of this whole arrangement, fig. 1, the film unwinds down through the lense barrel and intermittent feed mechanism 5, 6, 7, idlers 3, 4, 8 etc., and also through the sound registering parts 11, 12, 13 etc. When the moving subject is photographed before the lense 7, the accompanying sounds as voices, music, et cetera, are picked up by a battery of microphones "T," and transmitted electrically over the circuit to a lamp circuit 11. This lamp is a straight filament "Radox" or "Line-o-lite" bulb, subject to voice control by the microphone "T" variations in resistance; R is a resistance, I an inductance and C a choke coil.

Every changing sound causes the microphones T, to affect the brilliancy of the "Radox" lamp. These light variations representing the voice are photographed through a small slit in a screen 13 on to the moving film. The film must pass steadily by this slit and not with an intermittent

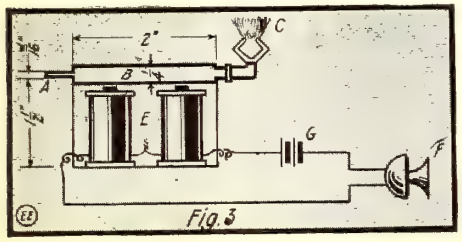


Fig. 3. Showing How the Voice Can Control Gas Flame.

motion, suitable propelling devices being used, of course.

After the sound is recorded the film is developed, fixed, and a print is made in the usual manner. It is then placed in a projecting machine with a selenium cell placed as shown at 16, connected in series with a source of current 17, and a loud speaking telephone receiver 18. The steady light from a lamp is thrown against the film through slit 13, and the voice wave bands of light and dark tones cause varying degrees of light to reach the selenium cell 16. Hence the cell has a constantly changing resistance, which is electrically communicated to the loud talkers 18, placed around the theater.

This loud-speaking telephone receiver is built on a new principle employing compressed air.

The usual method of recording photographically the voice on a moving film or plate is by means of a manometric capsule flame. This is arranged as per fig. 3, where an acetylene gas column in chamber B, is caused to vibrate by the varying electric current passing through the magnet coils E, controlled by a microphone F and battery G. This system has considerable promise for the future and opens up a wonderful field for experimenters.

For the last month radio amateurs and experimenters about New York have been greatly puzzled when listening to the powerful signals flashed off and on, the pitch of them being quite out of the ordinary. These signals are transmitted by the new Marconi Wireless Telephone at Wanamaker's, New York.

THE EDISON LABORATORY AND THE BRAINS BEHIND IT.

One can hardly imagine the great variety of wonderful inventions that have been developed in this small red brick building partly covered with creeping ivy. Thomas A. Edison, "prince of wizards," has spent many years and fabulous sums of money in perfecting his hundreds of inventions, some of which are more or less familiar to all of us.

The photograph herewith shows a recent likeness of Mr. Edison and his large laboratory situated at West Orange, N. J. Behind the large front windows is the wonderful library. It is in this library where Mr. Edison is encircled by thousands of books of every conceivable nature when looking up data for experiments.

Various departments are distributed throughout the laboratory building, such as the chemical department, where thousands of chemical reactions are critically studied; also the electrical, mechanical and research departments. It is in the latter department where Mr. Edison himself keeps continually busy. Every facility is afforded for thorough research in any branch of electrical engineering, and a staff of technical



"Prince of Electrical Wizards," Thomas A. Edison.



Below: The Wonderful Edison Laboratory at East Orange, N. J.

experts are kept busy at all times, delving into the never-ceasing wonders of Dame Nature's secrets, under the guidance of the master mind.

THE ELECTRO MAGNET, PAST AND PRESENT.

It is now 95 years since the discovery of the magnetic field which surrounds a

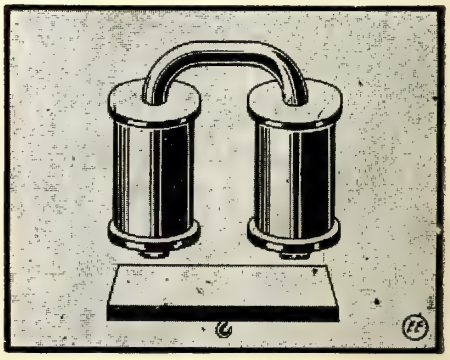


Modern Type Electro-Magnet Lifting Pig Iron from Freight Car.

conductor carrying an electric current. This was discovered in 1820 by Oersted, of Copenhagen, Denmark. We are herewith presenting an illustration of the first small electro-magnet, which was made by Faraday. Such electro-magnets were difficult to make, of course, in the early days, as the copper wire had to be insulated by hand or else specially made up in a hand spinning device. The other photograph shows the latest lifting magnet which is widely used by large iron foundries for transporting pig iron from one place to another, unloading freight cars and the like.

Powerful electro-magnets are often utilized in lifting submerged iron bodies, such as parts of machinery, barrels of nails, etc., lost in steamer wrecks.

The present electric lighting system depends entirely upon the electro-magnets in the electro-dynamic machine, driven, of course, by a prime mover, such as a steam engine, etc. Practically the entire elec-



Early Type of Electro-Magnet Such as Used by Faraday.

trical industry is based upon Oersted's epoch-making discovery.

One should always speak of the electromotive-force (E. M. F.) between two points; never of the E. M. F. in a circuit, except when one is speaking of an induced E. M. F. or voltage.

The Rôle of Electricity in Film Plays

By H. Winfield Secor

PHOTO-PLAYS of modern vintage are at last realizing the wonderful possibilities of scientific accomplishments, such as "wireless," in making their stories of more than ordinary or passing interest. Notably are these scientific facts utilized in weaving the story and portrayal of Pathé Brothers' *The Exploits of Elaine* and the Universal feature film play, *The Black Box*. These films are perhaps more highly scientific in a popular way than anything produced heretofore.

That thousands of dollars should have been invested in producing them brings to mind the trite old adage that "truth is stranger than fiction." This has been proven so time and again, but never more forcibly perhaps than in the film stories that we are now favored with, particularly those above mentioned.

We show herewith several illustrations of the more interesting critical moments from these two film masterpieces. At Fig. 1 is seen one of the greatest electrical devices ever perfected in use. It is the "electrical resuscitator," invented by Dr. Le Duc, of the Nantes Ecole de Medicine, France, and which machine actually brought a girl back to life recently out on the Pacific Coast after physicians had said that she had been dead for half an hour. Arnold Daly, "the scientific detective," is shown manipulating the switchboard, while the patient is "Elaine" in the person of Miss Pearl White.

In the photo at Fig. 2 the "scientific detective" is again seen (wearing a beard), and here the marvelous Poulsen telegraphone, the electrical instrument that records speech on a tiny moving steel wire, is being connected to the rear of a telephone switchboard. The detective and his assistant then leave the telegraphone installed for a few hours, the telephone conversation between the conspirators meanwhile being faithfully recorded by the instrument. Afterward the instrument and its important message are removed and in his laboratory "Craig Kennedy" reproduces the voice record and at once gleans the conspirators' intentions.

Many more wonderful electrical devices are incorporated in *The Exploits of Elaine*. One of these little known devices is the selenium cell, which changes its electrical resistance when exposed to light. The strip of film reproduced at Fig. 2A shows the well-known E. I. Co. selenium cell with polarized relay, bell and battery used in the Pathé feature film. The flash of a pistol in the conspirator's house lowers the resistance of the selenium cell on the lapel of "Craig Kennedy's" coat, and transmits its signal over a wire passing through a window to the police who are waiting to raid the conspirators.

Turning to the newer film release called *The Black Box*, it may be said that here many of the scientific possibilities not just yet perfected for our every-day use are portrayed in the mysterious tale it depicts so perfectly on the screen. At Fig. 3 the leading characters are observed receiving a wireless message by the ever-changing short and long sparks on the front of the switchboard. Of course, this is somewhat fantastic, as wireless signals are extremely small currents and invariably interpreted through the medium of a set of sensitive telephone receivers. However, to lend more charm and life to the film story, the sparks "coming in" are undoubtedly much more efficacious in their effect on the lay audience.

The important moment depicted in Fig. 4 embodies the ultra-scientific achievement of "seeing over a wire" as yet to be perfected, but which has experimentally been verified on a small scale by Herr Ruhmer, of Germany, and others. The picture materialized or reproduced from a distance over an electrical wire appears on the rapidly rotating disc, seen on the front of the switchboard at the left of the photograph.

Truly, the "movies" are becoming more educational every day.





Fig. 2A.
Above: The Selenium Cell Outfit in "Exploits of Elaine" Film.
The Latest Film Plays Are Using Extensively, Applied Scientific Apparatus and Methods.

Fig. 1. Shows Miss Pearl White in "Exploits of Elaine," Being Resuscitated by Electricity. Fig. 2. The Telegraphone in Use. Fig. 3. Receiving Wireless Messages by Code "Sparks," and Fig. 4. Seeing by Wire or the Telephot."

THE ATOM.

Sir William Crookes recently said, "We are on the brink of striking developments in our knowledge of the structure of the elusive atom." An expressive phrase is the "elusive atom," for every attempt to discover it has been to chase it further into the darkness. When Sir William says "on the brink" he means that point in the chase where mechanical means have done their best and material definitions no longer apply. Just over that brink is something besides matter. It is force or spirit, and all one can know of it is its testimony in terms of light, heat or electricity.

It has long been suspected that matter is a mode of motion, and now the elusive atom will be called upon to substantiate it. That is the purpose of science today. Suppose it succeeds and this whole universe is only an expression of power, what affect is that going to have upon our philosophy, our theology and human destiny itself? If man is only a little bunch of electricity, what is going to become of that electricity when he is no more? Since force is indestructible it is a very interesting question.

A 50-watt tungsten lamp costs one-half cent per hour to burn, with current cost of 10 cents a kilowatt-hour.

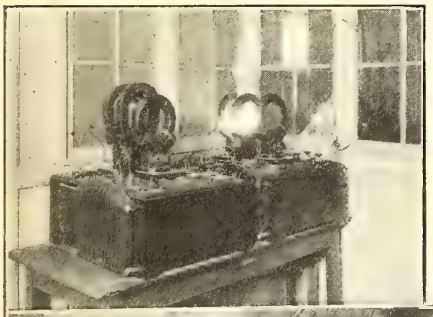
NOVEL A. C. FAN MOTOR.

A new alternating current fan has made its appearance in which variation of speed is obtained not by means of a rheostat, but by rotating the windings of the fan. The advantage of this is that the fan may be started at any position of the winding without danger of burning out by merely operating a push button. The energy that is consumed by the fan varies with its speed. When this fan is operating at full speed it takes 24 watts, and at the lower speed it consumes about 7 watts.

One mechanical horsepower (H. P.) is equal to 33,000 foot pounds.

The Work of the Electrical Testing Laboratories

The rapid development of the electrical industry has made necessary the solving of a great many electrical problems. To meet this condition a corporation has been formed in New York State for the purpose of making electrical tests and solving electrical problems. With the growth of the industry these activities have expanded until at the present time the Electrical Testing Laboratories, Inc., is completely equipped and has assembled a staff thoroughly experienced in electrical, photometrical and physical tests. The following photographs indicate some of the work carried on at the Laboratories.



Left: Fig. 2. Vreeland High Frequency Mercury Arc Generators.

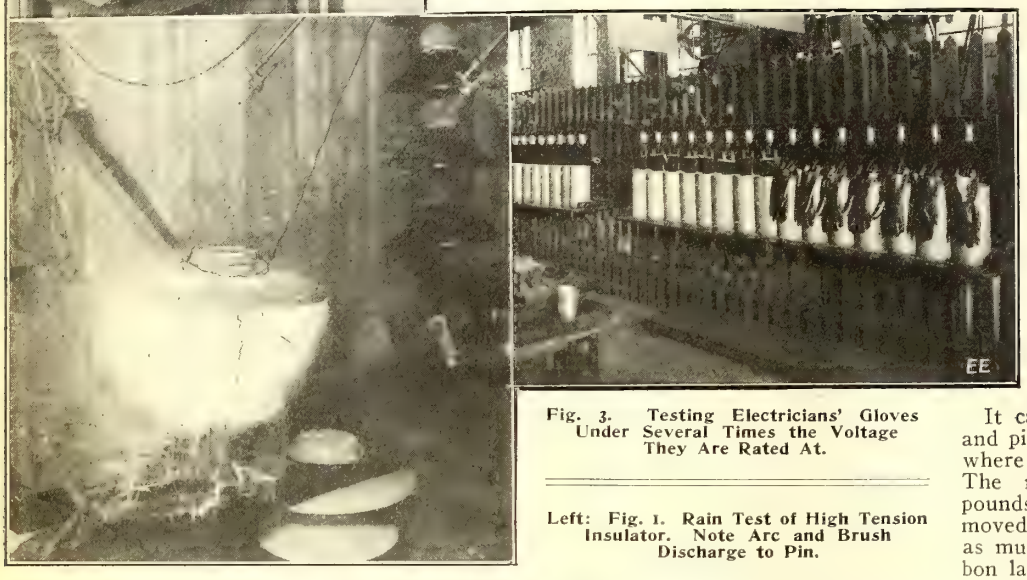


Fig. 3. Testing Electricians' Gloves Under Several Times the Voltage They Are Rated At.

Left: Fig. 1. Rain Test of High Tension Insulator. Note Arc and Brush Discharge to Pin.

Fig. 1 shows a large high tension transmission line insulator under an artificial rain test. This test is made to determine the performance of the insulator when exposed to heavy rain and wind conditions of weather, so as to determine how it will operate under the most unfavorable conditions which it may be called upon to withstand. This insulator is being tested to determine the point at which an arc will form around the insulator. In this case it is about 130,000 volts. Water is applied in a fine spray from nozzles at an angle of 45 degrees from the plane of the insulator, the amount of precipitation being one inch in five minutes. Many such insulators are purchased subject to the Laboratories' inspections and tests, the Laboratories' inspectors being sent to the insulator factories to make the tests in order to facilitate shipment. At this time over 750,000 insulators have been submitted to the Laboratories' tests.

Fig. 2 shows two generators giving a current having a pure sine wave shape. They are known as Vreeland sine wave oscillators and are used in testing at telephonic frequencies. The two machines are of similar construction, consisting of a mercury vapor tube so connected to condensers and inductance coils that the impressed *direct current* is transformed into a *high frequency alternating current.* These inductance coils are the two parallel coils at the back as seen in the picture. The third coil in front is the secondary coil from which the current is taken. The range of frequencies for the two machines as shown is 120 to 3,000 cycles per second. Other frequencies can be obtained by varying the condenser or by inserting other inductance coils.

At Fig. 3 is shown the method of testing electricians' rubber gloves. For this test the gloves are filled with water and immersed in a pan of water, one terminal being connected to the water inside the glove and the other terminal to the pan. The gloves are tested at various electrical pressures, depending upon the service which they are expected to perform. The gloves shown in the picture were tested at 10,000 volts for five minutes. In this test the electrical pressure is great enough to puncture the glove in any part which is defective. Tests of rubber gloves are, of course, vitally important, as the safety of the wiremen who must work on live circuits is on of the first considerations.

The photographs shown merely indicate three of the activities of these wonderfully well-equipped laboratories. There are hundreds of tests made by this company which might be described in the same way if the space would permit. The foregoing is given as a sample of the kind of service performed.

LAST CALL

Beginning with July 1st the subscription price of THE ELECTRICAL EXPERIMENTER goes to $1.00. *It is to your interest to subscribe now while the price is so low.*

THE ELECTRICAL EXPERIMENTER is the greatest value today in Electrical Literature. If you intend to subscribe to it, do it now. One year, 50 cents; 2 years for $1.00, *3 years for* $1.50. *5 YEARS for* **$2.00.** (*Foreign postage to be added.*)

CATCHING FLIES BY ELECTRICITY.

Think of it! 5,593,720,000,000 is the normal number of flies a single fly will produce from April 15 to September 10, according to the official statement of Dr. L. O. Howard, U. S. Government expert.

The electrically driven suction fan and cage here portrayed has been especially designed to meet a long felt want and is besides economical to operate.

By looking at the illustration one not familiar with a suction fan can easily comprehend the operation. A powerful suction fan is attached to the motor and the air, dust or insects that may be drawn into this fan are blown into a steel cage. Various types of mouthpieces are furnished with this machine, and extensions of 2-inch pipe can be made in any direction to catch flies, dirt or insects.

The feature of the sponge that is added to this enables one to putrify the atmosphere by water, a little drip cup at the top of the cage, which moistens the sponge, makes the sponge absorb the dirt in the atmosphere. The cage is easily removed. The light attached to the stand is for the purpose of attracting insects at night time, the mirror is placed in position with removable clasps; during the day time any sweet material placed at the openings will attract the flies. It is necessary to provide bait to attract flies. Banana oil or banana peel, stale beer or molasses attracts. It can be set in out of the way places and pipe connections made, or it can be set where most flies or insects accumulate. The machine weighs approximately 30 pounds and is thus portable and very easily moved from place to place. It consumes as much power as a 16 candle power carbon lamp.

The value of this machine to commission men, butchers, restaurants, bakers, slaughter houses and, in fact, any place where flies accumulate cannot be estimated.



Electrical Machine That Attracts and Catches the Terrible Fly.

The D., L. & W. R. R. recently conducted successful wireless telephone tests between a moving trains and station set, over a range of 63 miles, in mountainous country. Regular business made up the messages.

The average person is equivalent to 1/7 of a horsepower, as demonstrated by actual laboratory tests.

An Interview With Nikola Tesla, Electrical Wizard

By Samuel Cohen

THERE is no doubt about it—your heart does beat faster when you are about to meet a famous electrical scientist, one of the foremost in the world. Before you go you don't think so. It didn't beat a second faster when you entered the outer office, perhaps; but as I stood on the threshhold of the big waiting room where Mr. Nikola Tesla does his day's work my nerves were highly strung. Why? Why hadn't I felt like this when I had talked to other great inventors and scientists? I had been impressed, truly, by these men, but not to any such extent as when I entered the room where the master electrical wizard lives; he who has produced electrical discharges resembling lightning bolts.

After a few minutes, I was ushered into the presence of Mr. Nikola Tesla, who stood in the corner of the room awaiting me. I asked him regarding his latest achievements, but Mr. Tesla only smiled and told me first of some of his experiences some years ago, when he produced some of the largest electrical discharges ever attempted by man. He spoke of some of his wonderful experiments with high frequency currents at high potentials, which he made in 1899. The photograph Fig. 1, herewith shown, is one of the large Tesla apparatus for the production of very high frequency, high tension currents. This apparatus was built in 1899 for his plant at Colorado Springs. At this plant and in the same year he made a number of valuable discoveries. Among these was one on which a patent was recently granted to him. This patent covers the method of production of extra large electrical discharges, such as here shown.

This display of sparks will be the more appreciated when it is stated that the streamers from end to end measure 70 feet and the current leaping into the air is 800 amperes, with a maximum potential of 12,000,000 volts. The power supplied to this machine was 300 kilowatts. These voltages are high enough, but Mr. Tesla designed larger apparatus capable of reaching a tension of 100,000,000 volts. A machine of such power must be handled with the utmost care, as the slightest carelessness may kill the experimenter; even if he were at a considerable distance from the machine. Mr. Tesla stated that he had had several narrow escapes while experimenting in 1899, caused by "balls of fire" striking out into the atmosphere.





Top Photo Shows Largest Sparks Ever Produced by Man. Mr. Tesla is Seen Sitting. Seventy Feet Across Spark Streamers. Lower Photo. Mr. Tesla and His Marvelous Wireless Light.

The metal balls of the coil here shown are 80 cm. in diameter. The current oscillates at a frequency of 75,000 cycles per second. Some of these discharges were two and one-half times as large as common lightning discharges, and they could be heard twelve miles away from the apparatus. Mr. Tesla is observed seated and reading one of Faraday's scientific books.

This remarkable man has spent a fabulous amount of time and money in perfecting his apparatus for the transmission of electrical energy without the aid of any wires. The smaller photo, Fig. 2, shows Mr. Tesla holding in his hands a 14-inch glass bulb, which is highly exhausted and containing a drop of mercury. The electrical power received by this tube is obtained from a loop of wire located behind the screen, which is supplied with an ultra-high frequency current. The tube was not connected in any way to the apparatus. As soon as the current was sent through the wire loop a high potential current was induced in the bulb, which vaporized the drop of mercury, causing it to give forth a blinding light of thousands of candle-power. The photograph was taken by the light of this tube, with an instantaneous or snap-shot exposure. Mr. Tesla has a

(*Continued on page* 45.)

Baron Münchhausen's New Scientific Adventures

By Hugo Gernsback

YOU will chuckle with glee over the latest exploits of Baron Münchhausen. This is no doubt *the* scientific serial of the year. It accomplishes something unusual, it amuses while it instructs you. And by the way: just WHAT makes an apple fall from a tree? And what do *you* know about the mysteries of Gravity? The wily Baron will tell you.

How Münchhausen and the Allies took Berlin

I CONFESS that I put in a bad night after my first wireless telephone talk with the Baron on that memorable December night. My dreams were wild and fearsome and I awoke at frequent intervals bathed in perspiration. The whole thing was so uncanny, so preposterous, that when I finally awoke the next morning I began to really doubt if the whole thing had not been a wild, extravagant dream.

As yet I had not told anyone about Münchhausen for fear of inevitable ridicule, so when noon came around I had become thoroughly convinced that I had dreamt the whole thing from beginning to end. But when I sat down to lunch and my elder brother asked me why I had knocked him down on the stairs on his return from the lodge the night before, I knew that the episode was not a dream after all. So I told my people of my experience and recited my conversation with Mr. Münchhausen. They did not wax very enthusiastic as the story proceeded. When I had finished, my father took a deep breath, gave me a queer look and tapped his forehead with his index finger. That was the extent of his comment. He then gave vent to a disgusted snort and started with the soup.

My younger brother sung to the tune of *"Apple-blossom time in Normandy":*

"When the Nuts are getting ripe in Squirreltown!"

My older brother remarked casually that he had read not so long ago about an eminent Eastern doctor who found that strong wireless waves had the peculiar property of producing little explosions inside of the brain. A coherer action, as it were. This he said produced what the doctor termed a "wireless brainstorm!"

"A rather dangerous disease, closely resembling hydrophobia," my brother remarked, before attacking his stew.

The rest of my family all made similar intelligent comments, and as the case proved hopeless, I kept quiet and said nothing.

That evening, however, shortly before 11 o'clock I summoned the yawning, obstreperous members of my family to the wireless room and installed on everyone's head a wireless telephone headset, which latter were connected to my own trusty receivers. I then told my little audience to watch the clock and be prepared to listen to the most remarkable discourse ever held between two humans. Nor did I disappoint my audience. The clock had hardly finished striking the eleventh hour, when the (to me) familiar high-pitched screaming sound was heard again, and a few seconds later Münchhausen's voice vibrated powerfully in my own, as well as my audience's receivers:

"Good evening, my son," he said in his sepulchral voice, "I trust you have had pleasant dreams and that last night's experience has not disturbed you too much."

I hastened to reply that I was doing nicely, but that I found it difficult of persuading my doubting Thomases that his Excellency had really come back to life. At this Münchhausen laughed heartily and said he had expected that much. He added that if further proofs were wanted, he would be happy to give another lunar exhibition. He volunteered in addition to sweep the moon's dark quarter in any color we desired this very night, in order to convince even the most skeptical that his return was not a hoax. I could tell by the faces of my hearers that they were beginning to become impressed. A vote of the audience held right then and there determined the color to be green. I transmitted this intelligence at once to the Baron, whereupon he promised to light up the invisible dark quarter of the moon in a green phosphorescence for the duration of 20 seconds, beginning at 11.30 p. m. He added that our conversation was to be resumed after the "performance."

We thereupon repaired to the roof of the house, everybody keyed to the highest excitement by this time.

I will not go into lengthy details; suffice it to say that, true to his word, at exactly 11:30 p. m. Münchhausen swept the dark part of the moon's surface with an immense shaft of a green phosphorescence, similar to the exhibition he had given to me the night before. If anything, the light shaft was more powerful; this, however, might have been due to the earth's atmosphere being clearer than on the previous night.

I need not go to the trouble of explaining that every one of my family was thoroughly convinced. All were silent and awe-struck, and all were as ready as myself to believe anything that Münchhausen might say, and I assure you I was convinced throughout.

After the exhibition we resumed our seats in the wireless room, and I suggested that my brother take stenographic notes of the conversation, he being an expert stenographer, having been a reporter on the *New York Times* for five years.

I may add, therefore, that all conversations between Baron Münchhausen and myself, which I shall publish hereafter, are exactly as stated, taken from my brother's stenographic reports. The original notes are open to anyone doubting their truth.

After we had all been seated and the excitement had cooled down somewhat, I started my generator, tuned to 80,000 meters wave length, and spoke into the transmitter before me:

"Your Excellency, are you there?"

"Yes, indeed, my dear boy," it came back in encouraging tones; "now I suppose I will be bombarded with '42-centimeter' questions for the rest of the evening! What? Let it be known, therefore, that Baron Münchhausen is, as usual, ready for all emergencies. Pray, proceed!"

"Thank you, indeed," I responded, gratefully; "you are taking a load off my mind, for I certainly have quite a few questions for you. My first question, most naturally, is, 'How came you to select me with whom to converse?'"

"For two reasons: The first being that I knew you to be a truthful individual, the same as myself, far-famed and known as such in your country. The second reason is because I could hear your wireless signals, right here on the moon, proving to me that you were probably the only one with whom I might converse on Earth. My judgment, as usual, proved correct."

"Thank you for the compliment," I replied. "Now for my most important question: 'How on Earth have you ever landed on the Moon, and why?'"

The Baron laughed outright at my pun, and proceeded:

"That's a rather long-winded story, but I will try to explain.

"As I told you last night, when I came back to life, I had found myself in my old secret room. After my visit to the Mayor I returned to this room and proceeded to remove my treasure of 10,000 gold ducats which I had intended to take with me on my contemplated secret flight 110 years ago. It seems that instinct prompted me to exchange this currency for paper money at a local bank that very day. A lucky thing for me, as you will see shortly. You will believe me when I state that I slept easier that night, with those 20,000 ducats, exchanged into modern thousand mark bills, tucked away securely in my ancient wallet, under my pillow."

"But, your Excellency," I broke in, "did you not say a minute ago that there were but 10,000 ducats?"

"H-m. That's correct," chuckled the Baron, "but, my dear boy, you seem to forget entirely that gold ducats of the vintage of 1790 sell at a very high premium to-day, on account of the great scarcity of these coins! As a matter of fact, if I had peddled these coins to coin dealers and private coin collectors, I have not the least of doubts that I could have realized a great deal more.

"The next morning I was awakened by a fearful racket. It seems that word had traveled around that I was back to life, and my enthusiastic townspeople were bent on celebrating my return in a befitting manner. There were about ten brass bands in front of my house, and I estimate that at least three-quarters of the population were assembled around the bands waiting to see me. I dressed hurriedly and stepped out on the balcony, greeted with deafening *'Hochs,' 'Vivat Münchhausen'* and *'Lang soll er leben.'* Then someone yelled for a speech, to which I responded, delivering a befitting address for the occasion. I had hardly finished when two ladders were leaned against my balcony and two enthused *'Corps Studenten'* had carried me bodily down into a gala automobile, bedecked gaily with bunting. One of the students, in full dress, took his seat at the steering wheel, while ten others, also in full dress, started to pull the automobile in a triumphant entry through the city.

"It was indeed a strange cortege, and you will find a full report of it in the German daily press of September the 30th, 1907. The town was decorated with flags from end to end in a most elaborate manner, and after a wonderful day full of speeches and all kinds of honors bestowed

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upon me the day was befittingly closed with a tremendous illumination and exquisite fireworks. The next few days were crowded with hundreds of interviews to the press and with private individuals, while attention and kindness were showered over me unendingly. I tried hard to absorb all the new customs, and I had to ask numerous questions in order to become acquainted with all the strange things I met at every hand. As usual, my well-known versatility carried me through everything successfully, and it took me less than a week of concentrated study to become a fully up-to-date man.

"There was only one point on which I remained obdurate. This was my attire. I refused to clothe myself in modern clothes. I refused to put my beloved lower extremities into those foolish, modern, overgrown sleeves which you call trousers, nor could I see a single good reason for wearing those unsightly sacks which you call coats. Neither did close-cropped hair, which destroys the individuality of man, appeal to me in the least, nor, for that matter, those fantastic straw-stalk dishes which you call straw hats. Accordingly I stuck to my style of dressing, although I confess I had considerable difficulty in finding a tailor and a hatter who could accommodate me.

"Alas! my triumph was short lived. I told you already that before I had begun my century-long sleep I had committed a certain political offense against the then reigning authorities. You would naturally think that after a lapse of 100 years most any kind of political offense would be forgotten and outlawed. Not so in my dear fatherland. In Germany a political offense is worse than a thousand murders. Official Germany, or rather Prussia, knows no time limit when it comes to *lese majeste*. To make a painful story short, one nice autumn morning I was awakened roughly with the pleasant remark:

"'I arrest you in the name of the King.' Knowing me as a resourceful character, the authorities had sent no less than six well-armed *'Polizisten,'* to make sure I would not break away.

"I was made to dress in a hurry, and before I knew it I had been placed in the 'green wagon' and hustled to the local jail, there to await trial for my political wrongs committed 110 years ago. So does Prussia treat its famous men! Luckily for me that I carried my money in the folds of my high boots, for if I had not, they certainly would have found it. So you see ancient dress has its advantages.

"I stayed for two days in that prison, and I confess that I do not know what would have become of me had it not been for my many sympathizers and admirers. To the credit of the German people's fair-mindedness, distinguished from German officialdom, let me state that I owe my release. For at the end of two days, in the middle of the night, some 30 masked young men, all admirers of mine, rushed into the prison and overpowered the keepers and attendants, and I was put in a large automobile and rushed away in the dead of a moonless night. I was quickly conducted to a small town, where I lived in disguise for some weeks.

"Subsequently I made my way to the Dutch frontier, where I breathed easier, for I knew that I was safe from all danger here. The next day found me in Paris, where I settled down in one of the suburbs, with deep bitterness in my heart against official as well as officious Prussia.

"For the next few years I traveled extensively in Europe and America, as well as the rest of the world (with the exception of Germany), and in the course of my travels I had a great many adventures, which I hope it will be my pleasure to relate to you in the near future. Returning to Paris in 1910, my mind, which had always been of a scientific bend, turned to the study of electricity and chemistry, as well as to general physics, and in a short time I had made hundreds of wonderful scientific discoveries. Not believing in patents, especially in France, with her antiquated patent laws, I patented none of my inventions. Some day I hope it will be my pleasure to publish all of them for the benefit of humanity.

"The outbreak of the great war of 1914 found me in the midst of the study of several new inventions which I was trying to perfect. But I welcomed the war, nevertheless, with a glad heart. Here at last was my long hoped for chance to get even with Prussia against whom I had nursed a growing hate during the past few years. My *'révanche'* was at hand.

"The war had not been in progress for two days when I received an urgent call from my friend President Poincaré, of the French Republic. I called at once at the palace and was greeted cordially by the President, who shook me warmly by the hand. Only one other person was present, namely, General Joffre, chief of the French army, whom I had known intimately for the past few years. He also welcomed me and patted me affectionately on the back. I could see by the expression on their faces that some very serious business was to be transacted, and I did not find myself mistaken.

"'*Monsieur le Baron,*' the President began in a businesslike manner, 'from our past acquaintance I know you to be on our side, despite the fact that you are a born Prussian. Am I correct in my assumption?'

"'Yes, *Monsieur le Président,*' I replied fervently, 'it was my misfortune to be born in Prussia, but I assure you that there is to-day no more ardent, patriotic Frenchman in France than myself. Down with the tyrant Prussia!'

"'*Très bien,*' the President replied, gratified. 'I thank you. I will have you sworn in at noon to-day. As I know that you have made certain far-reaching inventions, I trust that you will do your utmost to turn these to the benefit of our great Republic. Any assistance which you might require will be given to you by the Government, and you will co-operate with General Joffre to destroy the enemy.



"In Less Than One Second Over 500 Men Were Baled Together Tighter Than a Bale of Compressed Cotton.

"'The French General Staff has already decided to invade Germany, by way of Alsace, in order to regain our lost provinces. Your efforts for the present, therefore, should be confined to that territory until your presence will be required elsewhere.'

"I thanked the President profusely for his great confidence in me, and hastened to answer him that I would not rest till the enemy was destroyed. I made it a condition, however, that I should have the power of requisitioning anything, no mat-

ter what it might prove to be, if in my opinion it was essential to use it at the front. This President Poincaré promised gladly.

"'All the Government desires, just now,' he closed, 'are results and victories over the enemy. France is at your service.' With these words we shook hands solemnly and the President left me alone with General Joffre.

"For several hours Joffre and I discussed various phases of the war, and after I had thoroughly acquainted him with some of my revolutionary plans of warfare we parted in high spirits.

"That very night I requisitioned every tank of laughing gas, as well as every carboy of chloroform, in the whole of France. I furthermore ordered every factory producing these articles to work overtime for 24 hours each day until further notice; immediately thereupon I requisitioned an immense factory at Levallois-Perret, a suburb of Paris, where for the next few days I kept 8,000 people busy manufacturing my requirements.

"You know, of course, of the French invasion into Alsace at the beginning of the war, and how we penetrated even beyond Mülhausen and Kolmar. But did you know how it was accomplished, and by whom? I think not. When history is finally written you will find that it was I who make the difficult work possible. I personally conducted the invasion and it was, indeed, a brilliant success. The first clash with the Germans was spectacular. We rushed upon them in the early morning, but instead of our artillery using the ordinary explosive shells we used my compressed laughing gas cylinders. These were constructed in such a way that they would open upon striking the ground. The soldiers of the rank and file were equipped with a similar device, who, instead of shooting bullets, shot compressed laughing gas cylinders. These cylinders were shot from the rifle at a rather close range and were not supposed to penetrate the bodies of the enemy. Instead, the cylinders had a soft rubber nose which, upon striking, actuated a trigger, and this in turn opened the forward end of the cylinder, releasing the gas.

"Our first attack proved as great an astonishment to us as to the enemy. When we began shooting the laughing gas at the oncoming ferocious-looking Germans their expressions changed suddenly to abominable grins. Most of them reeled and dropped right in their tracks; we had but to pick them up afterward as prisoners. I remember in a single day we thus captured 8,000 Germans.

"After the first rush we drove them back to their second line of trenches, and it was here where my chloroform bombs did wonderful work. Our artillery began shelling the trenches with my bombs; these, on striking the ground, liberated the compressed chloroform with disastrous results to the enemy. We literally drenched the Germans with chloroform, and those not killed outright were picked up later to be sent to France as prisoners, where they were put to work at manufacturing more laughing gas and chloroform with which to capture their countrymen.

"Thus we fought our way to Mülhausen, which we occupied triumphantly. I have no doubt that I would have fought my way across the Rhine, but just then Joffre got into trouble in Belgium and retreated into France. On his urgent representation I rushed to his aid, leaving my Eastern army in the hands of a young General whom I thought capable of continuing our Alsatian invasion.

"Unluckily, the Germans became wise to my bombs and began using some form of diving helmets, fastened over the heads, which kept the fumes and gases from their noses and mouths. This of course counteracted my bombs and made them obsolete. The Germans subsequently appeared in great force and drove my Alsatian invading army practically from Alsace, finally leaving it entrenched in the Vosges.

"In the meanwhile General Joffre had retreated almost to Paris before I could rush assistance to him. I am proud to state here that had it not been for me, Paris, as well as the rest of France, would have been in German hands. But Germany had not included Münchhausen in her plans of invasion.

"The great German General Von Kluck was but a few miles from Paris when I went into action. For a long time it has been a deep mystery to many people why he did not take Paris at that time and why he retreated so mysteriously and with so much haste beyond the rivers Marne and Somme. The explanation is found in the one word: Münchhausen. I had long since discovered that the German advance could not be stopped by ordinary means, so I adopted extraordinary measures.

"As is well known, France had been poorly prepared for the war. While there were unlimited stores of powder and guncotton, the artillery was sadly deficient in shells and our soldiers lacked bullets. As the manufacture of these important items is rather slow work, I commandeered all the French arsenals to turn out immediately rock salt shells and cartridges, which, instead of having bullets at their business ends, were filled with a goodly charge of the inexpensive as well as plentiful rock salt.

"From the minute these 'Salties' (as they were called affectionately by the French army) came into use the German advance had come to an end. We simply shot salt at the Germans.

"You may laugh at this and ask how it could have possibly stopped them, but the answer is as simple as it is surprising. The rock salt, when shot from a rifle or gun, had not enough piercing power to penetrate the bodies of the enemy, but it went easily clean through the soldiers' uniforms and then buried itself under their skins.

"If you have ever had a salty solution applied to an open wound you will appreciate what happened when I began pumping rock salt into the Imperial German army. No sooner had a soldier been shot than he would throw up both hands and begin to scratch himself furiously, with a zeal with which you would hardly credit the slow-moving Germans. Orders or no orders from his officers, *Hans* would scratch himself for dear life to get some satisfaction from the fearful itching. Finding that this did not bring the desired relief, instinct prompted him to run for the nearest water supply in order to wash the slight wounds free of the salt.

"By that time our gallant Frenchmen or British were upon them and they were made prisoners in less time than it takes me to describe it. It was quite a few days before the German General Staff got onto my latest device and promptly set out to checkmate me. One morning I received a report that my rock salt charges no longer acted in the usual prescribed manner, i. e., the Germans refused to scratch themselves when shot at. Instead, they threatened to drive us back. That afternoon we caught a few Germans and the mystery was cleared.

"The foxy German General Staff had ordered each soldier to wear TWO uniforms, one put on top of the other! Our rock salt charges could easily penetrate one uniform, but not two! Therefore I was forced to abandon my 'Salties,' and I turned my fertile brain in new directions.

"In a few days I was back to the front with a brand-new device. I am proud to say that of all schemes this one was probably the most effective. With its help we captured no less than 31,986 Germans in less than one week. President Poincaré personally attached the cross of the *Légion d'honneur* to my breast with the official thanks of the Republic. I am immensely proud of it to-day.

"As you will have noticed, all my own devices of modern warfare are exceedingly humane. If I can possibly avoid it I do not allow blood to be shed. I believe in taking the enemy alive.

"My well-known success, the *Human Self-binder*, illustrates this point.

"You are, of course, acquainted with the self-binder as used in harvesting. You know how the machine bales the wheat, putting a stout cord around the circumference of the bundle, holding the stalks together securely.

"This is the principle used in my *Human Self-binder*. It is simplicity itself and works as follows:

"Two of the famous French 75-millimeter guns were placed about 150 meters apart from each other, facing the oncoming enemy. The guns were loaded in the usual manner except that the shells were equipped with an eye-ring at the end facing the enemy. To this ring was fastened securely a strong but flexible steel cable about as thick as your little finger. Before firing, the cable would run into the mouth of the first cannon, while the other end of the cable was fastened to a similar shell in the second cannon 150 meters distant. Then the two guns were adjusted in such a manner that the cable was almost taut; the cannons themselves were leveled almost parallel to the ground. When the command was given the two cannons were fired simultaneously by means of electricity. The result was fearful when we first tried it on a regiment of charging Germans.

(*Continued on next page.*)

Can You

write a snappy, short story, having some scientific fact as its theme? If you can

Write

such fiction we would like to print it. The story which is appearing in the ELECTRICAL EXPERIMENTER at present has aroused so much enthusiasm among our readers that we have decided to publish more

Stories

from time to time. If you have the knack, try your hand at it. It is worth while. However, please bear in mind that only scientific literature is acceptable, altho not necessarily dealing with electrical subjects. "Baron Münchhausen" is a good example. Suppose you try. We pay well for such original stories.

"Electrical Dog" Follows Beam of Light

THE "soul yearnings" of a brand-new animal were recently expressed before a large and enthusiastic audience in the Auditorium, Chicago.

This new matinee idol is 'Seleno," the Electrical Dog, created and trained by B. F. Meissner, of U. S. Navy wireless and torpedo fame.

Seleno believes in hitching his wagon to a star; although a "star" himself, he follows a guiding light ray with absolute fidelity, a veritable chemico-electro-mechanical successor to the Magi of old.

Seleno is a barkless, biteless, hairless, tailless, semi-immortal phenomenon whose appetite calls only for currents—electric currents—that is—volts and amperes. His digestive apparatus is a storage battery, "fed" from the lighting circuit whenever he feels hungry. He moves on rubber-tired wheels in pursuit of the *beam of light* which he "sees" by means of two four-inch condensing lenses which constitute his eyes, and a pair of selenium cell optical brain centers. An electric motor actuates his drive gear and electro-magnetic relays control his course. His nose plays an important part in his following" ability, inasmuch as it is a thin opaque plate located between his "eyes," which shades one or the other eye when the light beam is not coming from directly ahead of him, causing his selenium optical centers to be unequally affected, the principle underlying his steering ability.

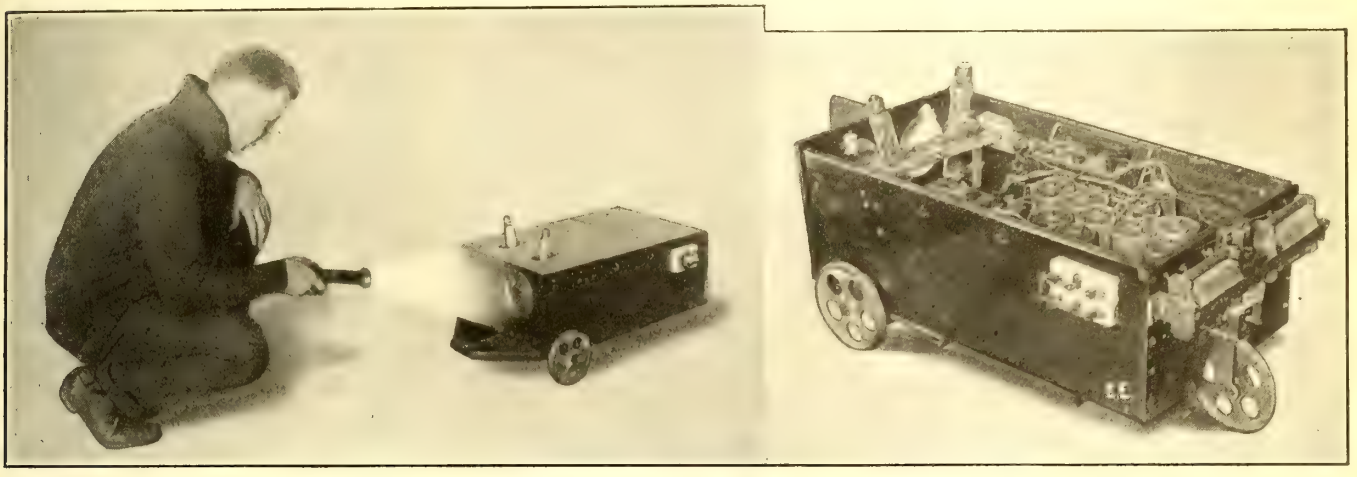
The most fanatical "Sun Worshiper" has nothing on Seleno. He would pursue a beam of light to its source, even to destruction; wherefore his master has endowed him with a reversing trigger as a preventive against suicide.

The few Chicagoans who have already been privileged to be present at a private recital by Seleno enthusiastically agree that he is beyond all question a "hound."

Mr. Meissner has developed several understudies, accomplished relatives of Seleno, who "support" him in his "act," demonstrating the remarkable properties of selenium in other startling ways. These lesser stars resolve the mystery of Seleno's fanaticism. A beam of light, directed upon a selenium cell, which is a non-conductor of electricity in the dark, lowers its resistance to the flow of current instantly; so in connection with a relay (or electro-magnetic switch), it can control the energy supply of any electrical device, from a simple incandescent lamp to an electric locomotive or smelting furnace. Likewise, it has been proved in Mr. Meissner's experiments that the deadly naval torpedo or even an automatic bomb-dropping aeroplane can be maneuvered in action from ship or shore by the same wonderful controlling agency.

By means of a small hand flashlamp directed at the "dog's eyes" (lenses behind which are mounted selenium control cells), his master causes the curious box on wheels to follow him about the stage, turning corners and avoiding chairs with no other control than that of the beam of light. By reversing a switch on the "dog" the mechanism was similarly made to back away from the source of light. The "dog" in each case started into motion quickly when the light was thrown onto its lenses and stopped just as promptly when the lamp was extinguished or turned away.

Storage cells inside the case furnish energy to drive the motor which propels the "dog." Each of the selenium cells behind the eye lenses controls a relay which actuates the motor and one of the two steering magnets at the rear of the device. Illuminating a cell on one side starts the motor and turns the rear wheel to that side; illuminating both cells equally causes the mechanism to run straight forward. Thus the action of the control mechanism is to keep the two lenses always equally illuminated and pointed at the source of light—in whatever direction that source moves.



"Seleno," the Electrical Dog, Obeys His Master Faithfully. Righ Hand View Shows Inside of the Dog.

BARON MÜNCHHAUSEN'S NEW SCIENTIFIC ADVENTURES.

(*Continued.*)

The two shells leaped forward together from the cannons, carrying the steel cable with them, now stretched taut. The cable, cutting through the air at a tremendous rate of speed, made a frightful, screeching noise. It 'sang' so loudly that it was easily heard over a distance of 35 miles. It was awe-inspiring.

"Have you ever as a child swung a cord with a stone at one end? If you have, you will have noticed how the string 'sung' louder and higher in pitch as you increased its speed. So it was with the steel cable, only the sound was increased a few billion times over that of your string. It went somewhat like this:

WHHEEEEEEEEE EEEE-EEE-EEE eeeeeeeee eeeeeee e e e e ehh . . . . . .

"The two shells then plowed their way through a few dozen soldiers, while the cable, catching the foremost men amidships, as it were, was stopped short, while the shells, carried forward by their momentum, continued to travel in their forward movement until stopped short by the cable. However, the momentum then carried one shell around to the left, while the other went to the right. In less than one second over 500 men were baled together tighter than a bale of compressed cotton, and as helpless as the latter. Most of the men at the point of contact with the cable were, of course, crushed to death by the tremendous pressure, but those on the inside, while nearly all of their breath had left them for the time being, were alive and were easily made prisoners by us.

"You have probably often wondered why, after the retreat of the Marne, the Germans dug themselves into their famous trenches. The answer is that this was the only means of escape from my human baler. As soon as they had found that they could not rush at us over the open terrain they went into their trenches, which naturally put my self-binder *hors de combat*, or out of business, as Americans are fond of saying.

"This put me at my wits' end for a few weeks, but not for very long. At the end of October, 1914, when all efforts to oust the Germans from their trenches had failed, I went to see General Joffre and said to him:

"'My dear General, we must now resort to a novel means in order to crush the enemy. Here is my plan: The Allies are now spending untold millions each day and no headway is being made against the Germans. Why not take 20,000 picked men, who know how to dig and mine, and order them to build a few gigantic tunnels right under the German trenches, emerging in some forests miles behind the German lines? Upon a given signal our armies would break through the openings and, while half of our men would fall into the enemy's back, the other half would be well on the road to Berlin. Simple, is it not?'

"General Joffre's enthusiasm over my plan knew no bounds. This otherwise silent man fell around my neck and embraced

(*Continued on page* 72.)

The White Feather

WIRELESS on the stage is not a novelty any more in these days. In the past, it has been used to a large extent to key up an audience in order to picture the emotions of a ship's wireless operator either when his own ship is in distress or when he is engaged in rescuing another ship. This phase having been worked to death, Messrs. Lechmere Worrall & J. E. Harold Terry left the beaten track and present us with the *Spy Wireless*.

"The White Feather," now running in its third month in the Comedy Theatre at New York, draws nightly large crowds, who seems anxious to enlarge their knowledge with the workings of the modern wireless spy.

The action takes place in an English town somewhere near the coast. Mrs. Sanderson and her son, both naturalized Germans, run a boarding house, but they are spies in the employ of the German government. Christopher Brent, an Englishman, considered an idiot by all, is a boarder. Everybody upbraids him, and a patriotic girl offers him a white feather as a token of her disgust, because he has steadfastly refused to enlist, nor can he offer a good excuse why he stays at home. He is, however, —Sh-H— a secret spy in the employ of the British government!

Left alone in the parlor, he empties the ashes from his pipe by knocking the latter against the casing of the fireplace. It sounds hollow. Very queer! Brent starts to thinking. He fumbles about the grate for some time and accidentally touches a secret spring, and— presto, the fireplace, which is but a dummy, swings upon its pivots and lo— a neat little "wireless" pops out, as faithfully depicted in our illustration.

The "wireless," made entirely of *"Electro"* instruments, is of course only an amateur outfit and is used by the Sandersons in transmitting important messages to the German submarines, lying outside the harbor, but a few miles distant from the house.

Whereupon Brent uses the outfit himself, gets all the information he needs by wireless and proceeds to put the outfit out of commission by wrecking the detector. Then he swings the outfit back into place and later on, by means of the knowledge thus obtained, also using a Detectiphone to good advantage in the evening, he finally rounds up the spies in a spectacular as well as exciting manner, wins the girl who almost became convinced that he is a coward and everybody is happy ever after.

Also, be it said here, Christopher Brent, who in everyday life is plain Mr. Albert Brown, is the "whole show." He has a difficult rôle and he acts it admirably.



A Breathless Moment in the Play, "The White Feather," When the Hero Picks Up German Spy Wireless Messages.

Six thousand eight hundred miles of hard-drawn copper wire was used in the recent long-distance telephone test between New York and San Francisco.

ELECTRICITY IN PLANT LIFE.

Some plants are electrically weak, others are strong, says Royal Dixon, author of "The Human Side of Plants," in the *Edison Monthly*. Perhaps the strongest; that is, in the sense of electrical vibrations,



An Electrically Sensitive Plant, Known as the "Mimosa Pudica."

is the sensitive plant (*Mimosa pudica*) shown in the illustration. Others, such as iris, nicotiana, nasturtiums, and practically all the meat-eating plants, such as the "Venus fly-trap" and the "sundew," afford splendid examples for experimentation. If any of these be placed "in connection with a galvanometer by means of electrodes attached to leaves on different sides, and one side of the plant be exposed to sunlight while the other side is kept shaded, then within from three to 10 seconds after exposure to sunlight there will be a flow of electricity from the lighted to the shaded parts amounting to .005 to .02 volt. This continues for about five minutes, when the magnet begins to swing back and shows an opposite current of considerable magnitude. The manifestations are similar to those of "teranized nerve."

A better understanding of the electrical qualities of plants will, no doubt, explain many of the hitherto mysterious habits of meat-eating plants. Especially will this be true of such terrible and uncanny plant monsters as the "devil's snare" of South America and the mammoth Utricularia, or fishing plant, which lures minnows and small animals into its voracious mouth, and suddenly, as if an electric button were secretly pressed, closes in upon its helpless prey. In other words, it fishes with a net electrically wired! Strange as it may sound this plant safeguarded itself by means of its electrical currents ages before we used the electric burglar alarm and door bell. Were it not for this protection, the plant could not live and hold its own in such an aurial-infested region as it needs for its fishing ground.

Many strange stories are told of a vampire vine, commonly known as the "devil's snare," which grows near Lake Titicaca in South America. This uncanny vine is like a huge snake and it is supposed to be able to capture wild animals as large as dogs and suck the blood from their bodies, just as an insect-eating plant catches a fly and draws nutriment from the carcass. The "devil's snare" is continually reaching out its huge white arms, which draw in every living thing that comes within its reach. This plant thrives in the inland region of the Nicaragua Canal.

A very peculiar plant, and one which has tremendous electrical powers, is the "telegraph plant" (*Desniodium gyrans*). It is a native of India, and each of its leaves is composed of three leaflets; the larger one stands erect during the day but turns down at night, while each of the smaller leaflets move day and night without stopping. They describe by means of jerking motions complete circles, not unlike the smaller hand of a watch.

EDISON RECEIVES CIVIC FORUM MEDAL.

"Inventor and World Benefactor" was the inscription on the gold medal of the Civic Forum which was presented to Thomas A. Edison on May 6 in Carnegie Hall, as a national testimonial. President Butler, of Columbia University, who presided and made the presentation, said:

"This gold medal is not awarded for any particular achievement, but for distinguished services and great scientific achievements and in recognition of a great career, which has a place among the very highest in the roll of human history."

A brilliant assemblage of world-famous engineers and scientists were present on this great occasion.

Guglielmo Marconi, the distinguished wireless inventor, was present on the platform and said:

"It would be useless for me to say that there is the greatest admiration for Mr. Edison in Europe. If anything, it is greater there than here. Americans may well be proud of the fact that Mr. Edison is an American. I am glad for us Europeans that Mr. Edison belongs to the world."

Letters from ex-President Theodore Roosevelt and ex-President William H. Taft, Alexander Graham Bell, and others were read by Robert Erskine Ely, a trustee of the Forum. Those who lauded the work and personality of Mr. Edison in addresses were Nicholas Murray Butler, ex-Governor J. Franklin Fort of New Jersey, George McAneny, Guglielmo Marconi, President Richard C. Maclaurin of the Massachusetts Institute of Technology, Charles A. Coffin, chairman of the board of the General Electric Co., Dr. John A. Brashear, the Pittsburgh astronomer, and Dr. Charles P. Steinmetz.

Percy Mackaye recited a poem he had written for the occasion. Here are the opening stanzas:

A thousand leagues on the Arctic sea
A ship went down through the frozen floe.
Captain and crew they watched her go:
They ran her colors free;
They cheered her lustily;
And far peoples chanted her praise with them
Where a phonograph, from her plunging stem,
Pealed to the stars her requiem.

A thousand leagues through the Afric wood
A man went looting the jungle's wealth:
Leopard nor lion could stay his stealth,
Nor sleeping-death nor flood:
He drew not the monsters' blood,
But he led them alive through the scorching day
By a tape of moving film, to play
With the wondering children of Broadway.

A thousand leagues, or a thousand years,
Are motes in the gaze of the seeking mind:
By its own radiance thought can find
Its way to ultimate spheres
Dark, till its beam appears
To blazen them. So on that beam hath run—
Round Arctic moon and Afric sun—
The electric mind of Edison.

The medal, which is one awarded annually by the Civic Forum for distinguished public service, was massive and elaborate. Last year it was awarded to Col. Goethals.

On July 1st the subscription price of the "E.E." goes to $1.00. *Subscribe now.* *See page* 38.

The Tower of Jewels at Frisco's Exposition

The Tower of Jewels, the dominating piece of architecture of the entire Panama-Pacific Exposition, is shown here, illuminated for the first time. That it does not belie its title is evidenced by its beauty when it is illuminated. There are 125,000 jewels or novagems used to decorate the tower which stands on the Avenue of Palms, and is the work of McKim, Mead & White, of New York. Each of the 125,000 jewels is backed by a mirror the size of 25-cent piece. The tower is a terraced structure, the principal features being the gigantic figures of the Philosopher, the Priest, the Adventurer and the Scholar; the work of John Flanagan, of New York. Under the tower are 44 feet long murals by Edward Simmons. This is only one of the many beautifully illuminated buildings at the exposition.



Photo (C.) by Underwood & Underwood.
The Beautiful "Tower of Jewels" at Night, San Francisco Exposition.

AN INTERVIEW WITH NIKOLA TESLA.

(*Continued from page* 39.)

number of startling new discoveries and inventions in the electrical field, which he does not care to announce at present, and he considers these latter of greater moment than any electrical work he has so far done. He intends in the near future to transmit wirelessly speech and energy around the world from his very powerful electric wave station on Long Island, which is as yet not completed, but which will be finished soon undoubtedly. Mr. Tesla stated, "that the day will soon come when he will show the world that the transmission of power and speech without the aid of any wires is possible."

Mr. Tesla was the first inventor of the induction motor and the system of alternating current power transmission, popularly known as two-phase, three-phase, or poly-phase systems, which created a revolution in electrical engineering and are now universally adopted.

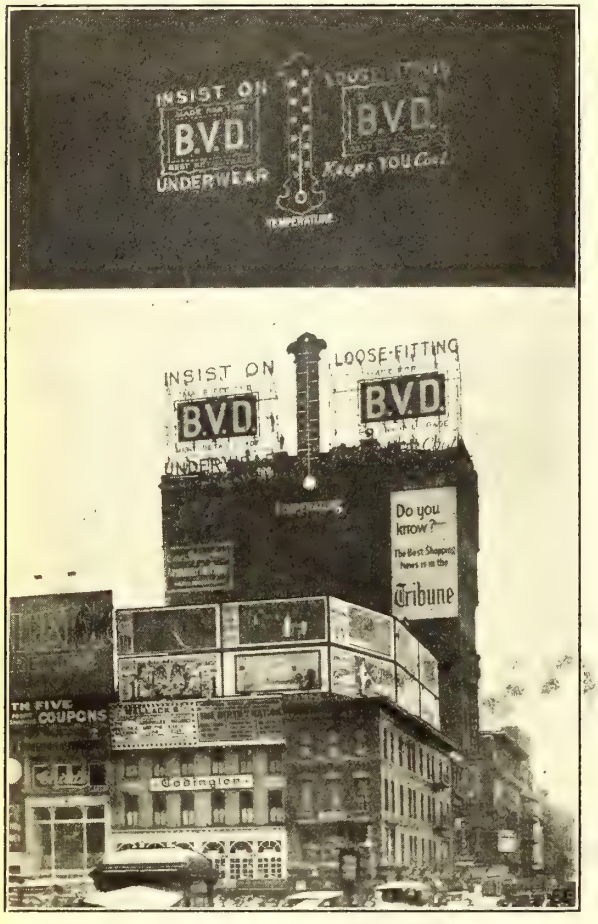
His most important recent work is the discovery of a new mechanical principle which he has embodied in a great variety of machines, such as reversible gas, steam and water turbines, mechanical transformers and transmitters of power, etc. This principle enables the production of prime movers capable of developing ten horsepower, or even more, for each pound of weight in the machine. His present prime mover could be very successfully used in the propulsion of vessels at extremely high speeds, he explained.

The allotted time grew short, and in a few minutes the great inventor bid me adieu and I left the presence of one of the world's most distinguished scientists of whom it has rightly been said: "He lives a hundred years ahead of his time."

AN ELECTRIC THERMOMETER SIGN.

A useful as well as an efficient advertising sign has been erected in New York City at Broadway and 43d street.

This unique sign is designed with a large electrically lighted thermometer, as seen in the day and night photos here presented. The thermometer is ingeniously controlled by electrical switches and circuits so as to always read the correct temperature by day or by night. Hence the Broadwayites can easily ascertain the correct heat value by a glance at the "B. V. D." sign, which can be seen for a considerable distance. Photo by courtesy O. J. Gude Co., the erectors.



Novel New York City Electric Sign Which Tells the Public the Exact Temperature at Any Time, Day or Night, by Means of Electric Lamps.

The size of the sign is 30-44 feet high by 93 feet long. Height of letters in "Insist on Loose-Fitting," 4 feet; of label, 21 feet; of letters "B. V. D." 9½ feet. The entire height of thermometer is 50 feet and its width is 7 feet. The diameter of ball at lower end of thermometer is 3 feet 3 inches.

IS VIBRATION THE BASE OF THE UNIVERSE?

By Garrett P. Serviss.

"Is it true that when a sound is so high pitched that we cannot hear it, it turns into some color, i. e., affects our optic nerve? Is the difference of colors due to the vibrations of matter? May matter itself eventually be resolved into different rhythmic motions?, asks a reader of the *New York Journal*, who has been answered by the noted scientist and astronomer, Garrett P. Serviss, as follows:

To answer your first question, consider these facts:

Sound is due to a vibration of matter (either gaseous, liquid or solid) of such a character and frequency that it affects our auditory nerves with a sensation which we call hearing. Ordinary sounds are conveyed to our ears by vibrations of the atmosphere, which consists of a mixture of gases. These vibrations are known as "sonorous waves." According to Helmholtz's experiments, the ear cannot detect any sound if the number of vibrations per second is less than 16 or more than 38,000. But this is an extreme estimate. All ordinary musical sounds are comprised between about 40 and 4,000 vibrations per second, covering about seven octaves. The lengths of the sonorous waves corresponding to frequencies of 40 and 4,000 per second are respectively twenty-eight feet and twenty-eight one hundredths of a foot, the latter being a trifle more than three and one-third inches.

Now, turn to light. Light is due to a vibration of a medium called the ether, or "luminiferous ether," which is supposed to pervade all space, and to pass freely through all matter, while being itself exempt from the ordinary limitations and properties of matter. Just as in the case of sound, the vibrations that give rise to the sensation of light belong to a series of waves only a small part of which possess the requisite length and frequency necessary to affect the organs of sight. It is important to remember the distinction that the "light waves" are in the ether, while the "sound waves" are in the atmosphere, or some other ordinary material substance.

If the rapidity of the vibrations in the ether is less than about 460 million-million per second, or more than about 680 million-million per second, they make no impression on the optic nerve, and we see no light. The wave lengths corresponding with the frequencies just mentioned are respectively aboue one 39000th of an inch, and one 58,000th of an inch.

Within these limits notable differences in the effects produced upon the eye by waves of various lengths occur. These differences are the origin of colors. The longest and slowest of the waves included in the limits named above, produce the sensation of red; the shortest and most rapid produce the sensation of violet; intermediate waves produce the sensations of orange, yellow, green, blue, indigo and intermediate shades. When all the luminous waves are blended together in the eye, they give the effect of white light.

From what has just been said, you will see that it would be impossible for such a direct relation, as your question indicates, to exist between the vibrations of sound and those of light. A sound that becomes so shrill that it passes upward on the gamut beyond the reach of the ear may still be a sound for some creature, like an insect, with an organ constructed to respond to vibrations of very high frequency. But it could not merge into the minute etheric vibrations that produce the sensation of color without itself in some manner passing over from the realm of ordinary matter into that of extraordinary matter, which seems to be occupied by the ether.

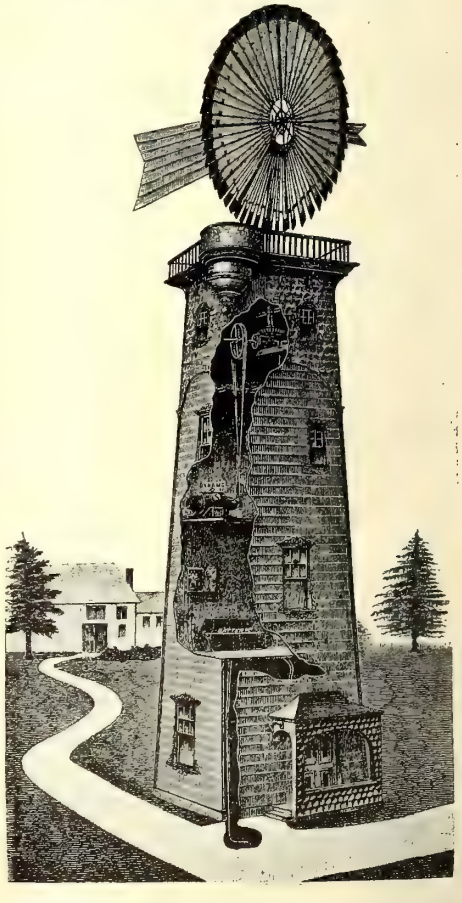
The third question leads to speculative ground. I may say, however, that everything at present seems to indicate that motion, of a rhythmic character, does lie at the basis of matter.

ELECTRIC LIGHT FROM WINDMILLS.

Electric lights from windmills may be very economically produced, and, in fact, is produced in this way a great deal in Europe and other countries. This practise is becoming gradually known, and utilized in the United States now; and with an installation costing $75 to $100 a fair size complete lighting plant can be installed for this drive.

Illustration shows a typical windmill electric power plant, including gearing and belt to dynamo pulley; automatic charging cut-out between the dynamo and battery, and the storage battery.

The principle on which these plants operate is quite simple. It is the same as if you had a pipe feeding into a water tank and every once in a while a quantity of water was discharged through this pipe over the top of the tank. In this way, the tank would gradually be filled although spasmodically, and the same principle takes place in the windmill electric power plant. The dynamo, whenever it is run fast enough by the windmill blade, pumps electric current into the battery. In the course of a day, the battery thus becomes fully charged in most cases. The lamps are lighted practically from the battery then; thus preventing any fluctuation in the brilliancy of the lamps, which would take place, of course, if the lamps were lighted direct from the dynamo in this case.



Windmill Drives Electric Lighting Dynamo and Charges Also a Storage Battery.

C. Pinkerton, of Spencer, S. Dak., says:

"Your *'paper'* is a very interesting one and I don't want to miss a copy of it."

Electricity in The War

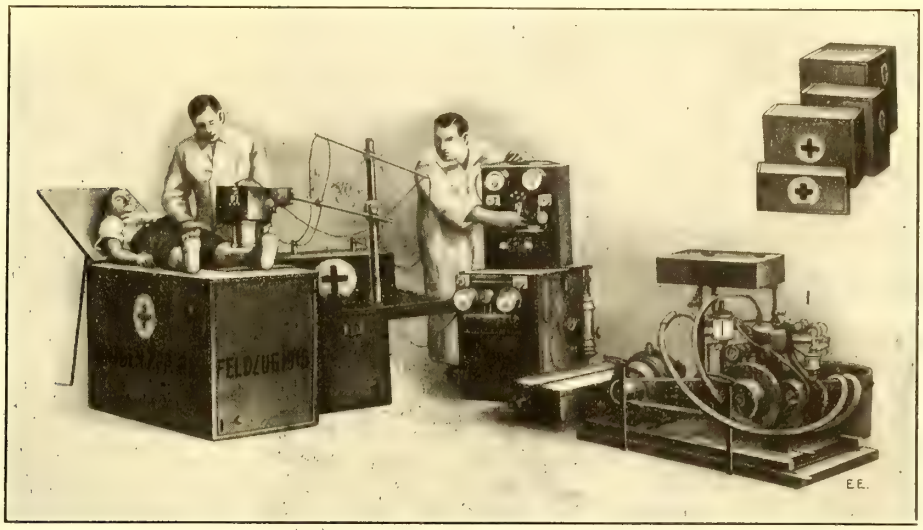
By Friederich Waldersee

(Berlin Correspondent of the Electrical Experimenter.)

X-RAYS IN THE GERMAN ARMY.

X-Rays have played a very important part in the wonderful medical corps of the German Army. It is probably the most important apparatus in their military hospitals.

One type of X-Ray machine, packed in four portable boxes, is illustrated here. The X-Ray apparatus herewith shown was especially developed by a German company, and six of these machines were transported lately to the Bavarian Army.



Ingenious Compact X-Ray Outfit of the German Army for Field Purposes.

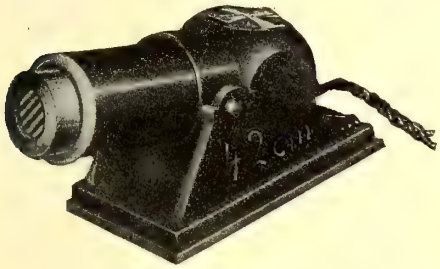
The electrical power, which the 30 cm. induction coil receives, is supplied by a dynamo driven by a gasoline engine. The case No. 1, in which the dynamo and engine is packed, also serves as an operating table when the engine and dynamo are removed, as observed. One side of the case, with suitable bracket arm, serves as an adjustable head rest. The second case contains a millivoltmeter, ammeter, and a a control switchboard. The switchboard is mounted on top of the cover. It is readily removed by turning and placing it in an upright position, which makes it then ready for use. A third case serves as a container for two X-Ray tubes; the case also serves as an X-Ray tube stand and houses the tube diaphragm holder, etc., in transit.

The powerful induction coil which supplies the X-Ray tube with the high tension voltage is sealed very carefully in a special box, in order to stand all kinds of rough use. Another case, No. 4, contains a set of storage batteries for emergency purposes, such as the failure of the dynamo and engine to work.

The apparatus has plenty of work to do, indeed, as it forms one of the surest methods of locating bullets, fragments of shells, etc., which may have entered the flesh and muscles.

NEW GERMAN WAR NOVELTIES.

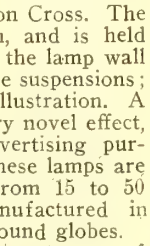
The two illustrations produced herewith give a good idea how the Germans are exploiting the war, even as to electrical novelties.



Cigar Lighter in Shape of a Gun.

The electrical lamp reproduced herewith is a tungsten lamp and its filament is shaped in the form of the Iron Cross. The filament is of a spiral form, and is held in position from the sides of the lamp wall by means of the ordinary wire suspensions; these are not shown in our illustration. A lamp of this kind gives a very novel effect, particularly if used for advertising purposes, patriotic fetes, etc. These lamps are at the present time made from 15 to 50 candle power and are manufactured in pear shape form as well as round globes.

Our other illustration represents one of the famous 42-centimeter guns, of which we have heard so much in the war. It is, however, not a gun and only the outside shape conforms to same. It is nothing more or less than an electrical cigar lighter in the shape of a gun; a lamp cord connected to the back of the gun is used to make connection with the electric circuit for 110 volts. A simple arrangement is provided which makes the front end glow as soon as the gun is picked up from its base; the housing is made of a brown zinc casting. The design is very pleasing, and there seems to be a good market for a device of this kind in Germany at the present time.



ARC LAMPS IN HIGH GAS PRESSURES.

It is stated in the "Elektrotechnische Zeitschrift" that Prof. Lummer, of Breslau, Germany, has run arc lamps under pressures of 20 atmospheres absolute, and obtained intrinsic brilliancies 18 times higher than those obtained at ordinary atmospheric pressure, the calculated temperature rising from approximately 4,200 deg. C. to about 7,500 deg. C. The experiments are to be continued.

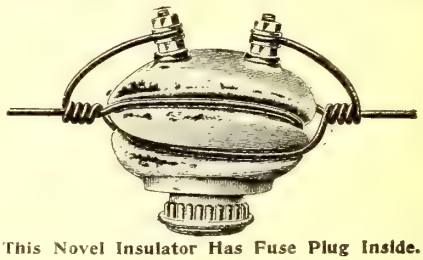
EFFICIENCY OF THE ELECTRIC ARC.

The "Elektrotechnische Zeitschrift," (Germany), shows two developments tending to increase the efficiency of the electric arc. One of these is due to Dr. W. Wedding, who heats the ends of the carbons by means of a flat non-luminous flame, though it appears that the actual function of the flame is to cool that part of the carbons to which it is applied. From the information that is given the arrangement is not altogether clear. It is obvious that if the efficiency of an arc is to be increased, the current density in the luminous part of the electrode must be increased so as to obtain a higher temperature. Evidently this desideratum has been achieved by Dr. Wedding, as the candlepower in a certain direction is raised from 30,000 up to about 100,000 Hefner candles, although the temperature of the carbons in certain parts has been reduced.

The idea of cooling has also been attempted in this country, and in this case alcohol vapor was the cooling medium. From the practical point of view, however, increase of pressure does not seem to be a very promising direction in which to work.

NOVEL GERMAN INSULATOR.

In a recent issue of *Helios,* a German electrical paper, appears the cut here reproduced of a novel porcelain line insulator, which combines means for anchoring

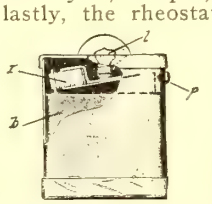


This Novel Insulator Has Fuse Plug Inside.

the two wires as well as a fuse plug. It is suitable for a variety of purposes, such as lighting lines and telegraph or telephone circuits. The fuse connections are brought to two binding posts as perceived.

A NOVEL FLASHLIGHT RHEOSTAT.

A rheostat built in the flashlight is the latest German novelty. This obviates the tendency to burn out tungsten bulbs of low rating used on fresh batteries as seen from the illustration. There is the usual battery b, lamp l, push button p, and lastly, the rheostat r. This adjustable resistance r consists of a few feet of wire wound on a tube, with a slider arranged on the brass piece making contcat with the center or base of the lamp. To insert more resistance, for fresh battery, the coil is removed and the slide moved toward the right. Then it and the battery are replaced. Tungsten lamps of 2.5 to 3.5 volts rating can be used with a battery yielding 4.5 volts when fresh. As the battery ages, the rheostat enables one to adjust the voltage to the lamp as required.



AN OBSERVATION CAR ELECTRIC SEARCHLIGHT.

By Frank C. Perkins.

The accompanying illustration shows the first electric searchlight on a railway observation car, installed on the fast mail train operated between the Twin Cities and Chicago on the Chicago, Milwaukee & St. Paul Railway. The searchlight, 13 inches in diameter, is placed on a pedestal 52 inches high over all, taking up 16 inches of floor space on the observation platform. The carbons are ½ and ⅝ inch in diameter, specially constructed for searchlight work. The carbons stand horizontally and operate automatically after being focused. The lamp is built to operate on a 60-volt electric current, and requires 20 amperes, throwing a stream of light for a distance of two miles.



The Latest Attraction on a Western Railroad Train. A Powerful Searchlight Illuminates the Scenery at Night.

It is stated that the condensed view of the light after leaving the reflector is equal to 4,500,000 candle-power. It will be seen that the lamp is mounted on the observation car platform at the end of the train and it is in charge of an experienced operator, providing a means by which the passengers on the train can view the scenery after nightfall. The St. Paul Railroad runs parallel to the Mississippi River for over 100 miles, and the boats, curious rock formations and the features of the landscapes come out clearly in a very interesting manner by the use of the powerful searchlight. The searchlight can be moved 90 degrees horizontally and 45 degrees vertically, thus making objects visible for a distance of several miles around as the train speeds along.

READER'S VOTING BLANK.

What do you like best in the *Electrical Experimenter?* We don't know. We can only guess. Sometimes we guess right, often wrong.

Will you help us by telling us what appeals most to you? Only by means of your aid can we bring this magazine to perfection. It is easy for us to give you what you like most, *but you MUST tell us.* We will take a vote among our readers and carefully classify results. We promise to be guided wholly by this vote, and will publish the results in the August issue.

Fill in the spaces below by placing a figure in the square alongside of the subject in the order of your preference. Thus, if you like the wireless department best, place Fig. 1 alongside of it. If your second choice is "Patents" place a figure 2 alongside of it. If "Among the Amateurs" is your third choice placed a 3 alongside of it, and so all the way down. This will guide us absolutely. And be sure to give us your *frank* criticism. When the blank is filled out cut it out and paste it on a postal.

It costs but one cent to vote, and you will get just what you like most. So before you turn the page fill out the blank, NOW!

VOTING BLANK

I give below, in the correct order of my preference, my choice on subjects in the *Electrical Experimenter:*

General Electric Articles.....	☐	CRITICISMS:
"Münchhausen"	☐	.....
Electrical Experiments.....	☐	.....
"The Constructor".....	☐	.....
"Wireless Department".....	☐	.....
"How to Make It" Department.....	☐	.....
Electrical Magazine Review.....	☐	.....
Latest Patents.....	☐	.....
Among the Amateurs.....	☐	.....
Question Box.....	☐	.....

I would like to see you print more.....

Name.....

Address.....Age.....

NEW RADIO-ACTIVE ELEMENT.

Prof. Goehring, of the Physico-Chemical Institute at Karlsruhe, Germany, announces that he has discovered a new chemical element which he calls brevium.

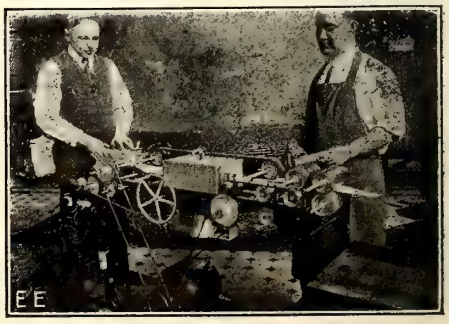
He states that brevium is radio-active and results from the disintegration of uranium.

Dr. Sinclair Tousey, expert in radio-activity, says of the discovery by Prof. Goehring:

"There are a whole series of dinintegration products of radium and thorium, and six or eight of these are already definitely known to chemists. Radium, of course, is the best known; another is mesothorium, which is of very great practical importance—more so than perhaps any of the others of the group, with the possible exception of radium. It is used in medicine, especially in Germany, for the same purposes as radium and to a much greater extent, for it is only half as expensive. Also it is only half as active. On general principles it is probable that the new element discovered by Prof. Goehring would have roughly similar qualities to those of the other elements of the group. Inasmuch as the fact that a large number of such derivatives exist was known the isolation from time to time of any one of them is a thing not altogether unexpected in the scientific world."

ELECTRICALLY DRIVEN ENVELOPE SEALER.

A new electrically driven machine which will seal several thousand envelopes an hour has recently been perfected in the Government Laboratories at Washington, D. C. This machine is shown in the illustration, and the operator at the left is feeding a batch of envelopes into the machine. These pass through the various rotating friction drums; as will be perceived, and in the course of their journey, pass through a vapor bath, created by a small vaporizing tank placed at the center of the machine. This vaporizer is operated by a small alcohol torch applied underneath. An electrical heater can be used.



Uncle Sam's New Envelope Sealer.

This device is open to the public, as far as making duplicates is concerned, and anyone may enjoy the benefits from this particular invention without any cost for patent rights.

Electrical Fishes.

PERHAPS in all life there is nothing more interesting than electric animals, and yet but little of their real nature is generally known. Only in this new age of electrical wonders and

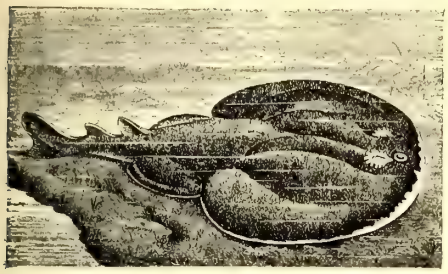


Fig. 1. The Electric Fish Known as the "Torpedo."

miracles have we been brought face to face understandingly with the marvels of nature; to-day we know that every living animal evolves in various ways enormous amounts of electricity. There are both animals and insects that are remarkable electric batteries, strikingly like the electric appliances which we use. Cats give forth sparks of electricity when their fur is rubbed in the dark, and even man himself is a walking electric dynamo.

The most curious of electric animals is a certain fish which discharges shocks at will to defend itself. It is a huge flat fish, known as the "torpedo" (Fig. 1), belonging to the sun tribe, and frequenting the waters of the Mediterranean Sea. Sailors and fishermen tell many strange and weird stories of this sea-electrician. Frequently they claim to have found their arms bound by the invisible and mysterious current of electricity sent up the line by the fish below. Until recent years these phenomena were regarded by seafarers with superstitious awe. Ages before this fish's electrical powers were understood, certain Roman physicians kept large aquariums of them and patients were allowed to touch the "torpedo" and receive shocks, as a means of curing certain diseases.

There are two other electrical fish, each belonging to the fresh water regions of the tropical countries, which rival the "torpedo" in their electrical powers. These are the *Gymnotus electricus* (Fig. 2) and the *Silurus electricus* (see Fig. 3). In each of these fish electricity is developed by specific organs, which are not unlike the form or shape of a voltaic battery.

The electrical organ is used by these fishes in order to catch or kill the prey; also to ward off attacks from other fishes.

In Fig. 4 we show the electrical organ of one of these fishes; this is to be distinguished into two separate parts, namely, the nerves and the special organ into which these nerves branch out. This organ is

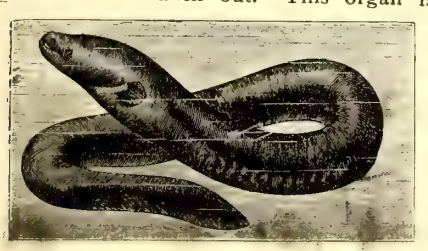


Fig. 2. Electric Eel, "Gymnotus Electricus."

always built up of a great many discs or plates, which, however, vary in size and shape as to the different fishes. These discs or plates are really a curious form of muscle.

At (a) Fig. 4 will be seen the frontal brain from which branch out the nerves (r). Then follows the central brain and after this the small brain and finally the large lobes (b), which form the electrical central, the so-called *"lobus electricus."* From this a great many sets of nerves branch out, which are then distributed over the electrical organ (cc). This takes up much of both sides of the brain, as well as a part of the back. It also occupies a large amount of the forward section of the body of the animal.

The discs or plates mentioned above lay on top of each other and form an organ which can be best compared with a voltaic pile. It is probably very similar in certain respects to Galvani's first battery. In Fig. 5 we show one of these organs, (a) being the nerves as they branch out over the discs.

In Fig. 6 is shown a large magnification of one of these discs. A part of the nerves go to the inside of the disc, then branch out and end in a grain-like mucous mass in the form of small sphere-like cells (bb). Another part of the nerves then branch out into the protecting tissue (cd).

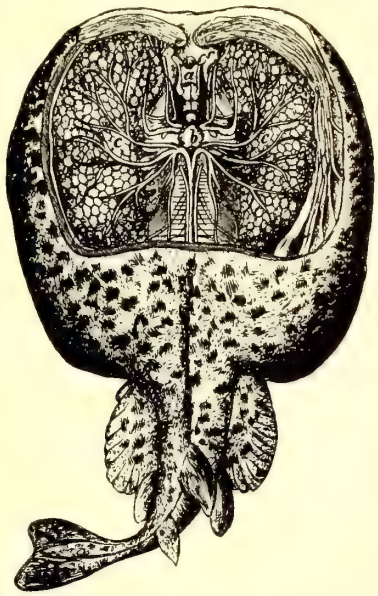


Fig. 4. The Frontal Brain of an Electric Fish.

The electrical nature of the shocks of these fishes has been studied experimentally by Walsh as early as 1773. He has shown that, for instance, the *"silurus electricus,"* as shown in Fig. 3, is only capable of giving electrical shocks when the back as well as the belly are touched together. In this case the human body forms a path through which the electrical current passes. Of course, one can get a very strong electrical shock even if one does not actually touch the fish in the above manner with the hands. For instance, a wet rope or any other object which is a good conductor when touched by the hand will transmit the electrical energy when the fish touches it. For this reason it is also possible to obtain a powerful shock directly through the water.

The first shock of one of these fishes is very powerful and sometimes is strong enough to paralyze or even kill a horse. The second shock, however, is already weak, and after a few shocks the fish is not able to give out any more electric energy. It takes quite a time for the fish to accumulate and again charge the cells electrically.

The most formidable of these electricians is the *Gymnotus electricus* of South America. History relates that many fords and rivers have been abandoned because of these strange shock-givers which infest them. The early Indians, who lived near to nature, took advantage of their knowl-

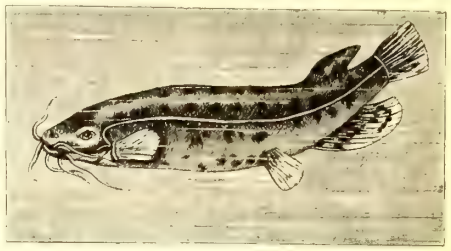


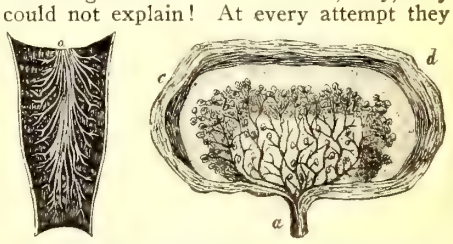
Fig. 3. Another Specimen of Shock-giving Fish Called the "Silurus Electricus."

edge concerning these creatures and caught wild horses by driving them into infested ponds.

The streams near Caracas, South America, are overrun with the much-dreaded *Gymnotus,* and the natives use a strange method of capturing both horses and fish. They call this method "intoxication by means of horses." When a herd of wild horses is driven into one of these fish ponds, the fish are awakened from their slumbers and ascend from the bottom of the water, darting here and there. Their great yellow, snake-like bodies are hurled against the terrified horses, which, with staring eyes and distended nostrils, fiercely paw and kick as they endeavor to plunge their half-paralyzed bodies out of the water. Some of the horses are immediately killed by the electrical shocks of these fish, but the others may be easily captured by the native who is usually mounted on a horse trained for the work. This form of horse catching is very popular.

These powerful fish show a fiendish ingenuity in using their electrical powers. They seem to know the most vulnerable points of attack, for they glide under the horse, give the fatal touch near the heart which acts like lightning, and glide away to safety. This they repeat until their electric force is exhausted, when they float to the surface of the water and may easily be caught.

A few years ago, when electricity was not so well understood, and experiments with electric animals practically new, an electric craze went over the civilized world. Electric fish were much in demand; their curative powers were extolled, and hospitals and sanitariums kept them for their patients. Even enterprising showmen and street fakers took advantage of the craze; everywhere were seen aquariums tagged with signs offering big rewards for the one who could lift the fish out of the water. This offer was accepted by numerous strong men, but they never succeeded in removing the fish from the tank, why, they could not explain! At every attempt they



At Left, Fig. 5, Shows Nerves Branching Out Over Disc Organ. Right, Fig. 6, Enlarged View of Sphere-Like Cells of Electrical Fish.

tumbled over from the shock, while the curious crowds jeered and laughed.

As to the power of these electric shocks

(*Continued on page* 50.)

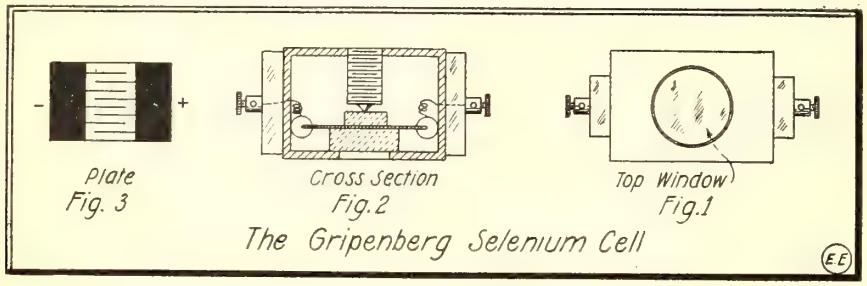
THE GRIPENBERG SELENIUM CELL.

By Samuel Wein.

Of the various forms in which selenium cells have been constructed, the most efficient is that made by William Sebastine Gripenberg.

The cell consists of a small screw-press by means of which a very thin plate of selenium is pressed against the electrodes.

The electrodes are made as follows: A glass plate is covered with a thin layer of gold. By means of a sharp tool, the film of gold is removed in a way as shown in Fig. 3. The electrodes form a fine grating whose bars are at a distance of about 0.35 mm. from each other, and there are 12 to 21 bars per mm.



The properties of the cell depend mainly upon the thickness of the selenium, as the action of light is limited to an extremely thin layer of the exposed surface (calculated by Marc to be about 1/500,000th inch thick). Thin plates of selenium generally give high resistance, high sensibility, and rapid recovery after exposure to light.

Mr. Gripenberg discovered that selenium, when molten between a cold and a very hot glass plate, strongly adhered to the latter, after the annealing (crystallization). It is thus possible to cover a thin glass plate (1/250th inch thick) with an exceedingly fine film of selenium (between 0.01 and 0.0001 mm.) having a very good contact with the electrodes.

The most important point, however, is that a thin layer of amorphous selenium (less than 0.01 mm.) cannot be converted into metallic selenium by heating, on account of its contraction or decrease in volume (5 to 8 per cent.) and collects in drops like mercury; as soon as a temperature of about 90 degrees C. is attained. This contraction is prevented by applying the selenium with a coat of a suitable lacquer (celluloid Zapoulach).

The conductivity of such cells in strong light may be 1,000 times greater than in the dark. Resistances corresponding to the above thicknesses are the following: 10,000 ohms dark, 2,000 ohms light; 100,000,000 ohms dark, 100,000 ohms light.

Cells constructed according to this method are very reliable and show remarkable constancy, and are well protected from outside influences; moreover, a selenium plate that for some reason has lost its efficiency can be easily replaced by another piece, at small cost. Antimonite having the same photo-electric property as selenium can also be used in the cell.

LOST! ONE WIRELESS MESSAGE.

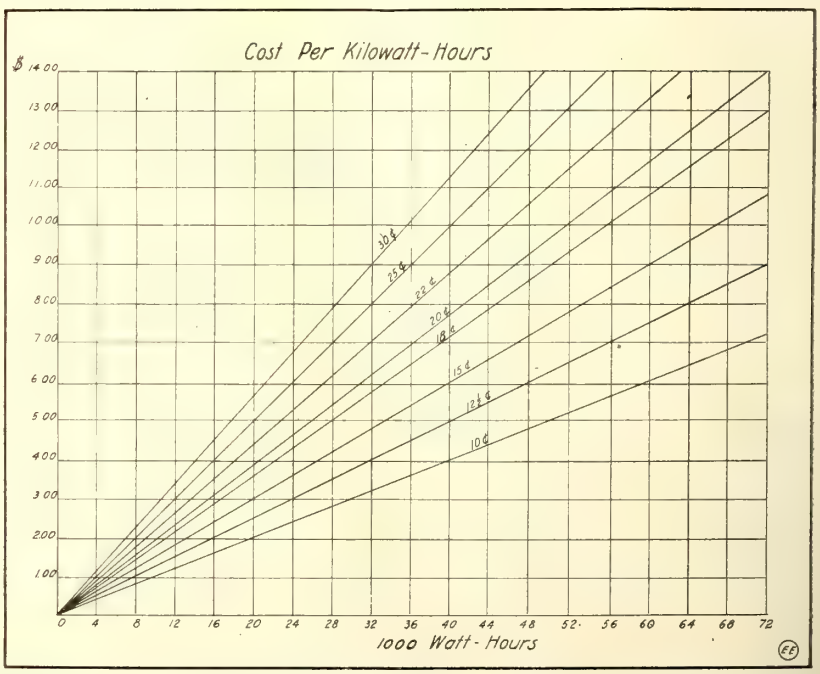
A complaint of the Berliner Handelsgesellschaft recently stated that a wireless message sent by them to the United States from Eilevese, Germany, via the Tuckerton transatlantic radio station was lost somewhere between the sending point and its destination; New York City. [*Perhaps one of the English cruisers, parading up and down our coast, nabbed it. What?*]

MORE WIRELESS TIME SETS.

A wireless outfit has been installed by Jeweler Prescott, of Oakdale, Calif., for receiving the correct time directly to his office. At noon each day the correct time is sent by wireless all over the country, and anyone having an instrument installed can take the correct time when the signal comes at noon. A set of wireless instruments can be installed in an isolated quarter, where telegraph or telephone lines do not reach, and can receive and send messages and receive the correct time.

HOW TO COMPUTE YOUR ELECTRIC BILL.

Those who use electric current from central station service will find the curves here given convenient in computing the total cost of energy in dollars for various kilowatt-hours. Electrical energy is sold by the kilowatt-hour, usually, which represents about 1 1/3 horsepower used for 1 hour, or ten 100-watt Tungsten lamp load for 1 hour, or a couple of 500-watt electric sad irons for 1 hour, etc. Ordinary 16 C. P. 110-volt carbon filament lamps consume about 55 watts an hour or 10 of them would take .55 K. W. H. To find the K. W. H., knowing the total watts used, divide by 1,000 (1,000 watts equal 1 kilowatt), and multiply by the number of hours the current is used.



To Figure Directly Your Electric Bill; Look Upward on Line Corresponding to Thousands of Watt-Hours Used, Until it Strikes the Slanting Line Marked with Your Rate. From This Intersection Look Over to the Left and Read Total Bill in Dollars.

In the curve chart here given, the base line represents K. W. H. For instance, suppose you use 1,000 watts for 40 hours. Then you have 1,000 divided by 1,000, equals 1 kilowatt and this times 40 gives 40 kilowatt-hours. Suppose your K. W. H. rate is 10 cents. Then, looking up the vertical line until the 10 cent diagonal is reached and following the horizontal intersecting line over to the left, the total cost is seen to be $4.00. Fractional amounts are readily judged or a new chart is readily made by anyone interested on a piece of cross-section paper.

ELECTRICAL FISHES.

(*Concluded.*)

—numerous experiments have proven that they greatly vary in degree; a bird will topple over dead if it chances to light just above a "torpedo." And this is not astonishing when we remember that men are completely paralyzed when spearing these creatures.

The eminent Dutch surgeon, Gramund, found that the effect "produced by the fish corresponded exactly with that produced by the Leyden jar, with this difference; that we see no glitter on its body, however strong the blow it gives; for, if the fish is large, those who touch it are struck down."

Humboldt was one of the first to examine carefully the batteries of electric fish. One tremendous monster was captured near Calabazo, which, by means of its shocks, killed a mule and seriously injured the rider. The huge fish was finally hooked, but the line becoming wet the fish communicated such shocks to the captors that they were powerless to move and were held as though by electric wires. They finally succeeded in bringing the monster to the shore and found that it was twenty-two feet in length. It had practically the same relative size throughout its entire length, with a broad head, compressed tail and the under side of the body lined with four natural electric batteries, two on each side. The strange plates and the batteries were vertical, not horizontal, as in the "torpedo," and each was supplied by nerves from the vertical branches of about four hundred spinal nerves. Such monsters, armed as they are, might well prove dangerous, a touch of their tails frequently bringing sudden death.

There are unquestionably numerous other electric animals and insects yet undiscovered. Perhaps the time is not far distant when the presence of electricity in all forms of life will be an accepted and proven theory.

How to Build a Telegraphone

By Samuel Cohen

THE telegraphone is an electro-magnetic instrument which records the human voice, music or other sounds on a fine moving steel wire, and these sounds are reproduced as perfectly as in a telephone, if not more so.

The invention of this instrument is due to the researches of Valdemar Poulsen, the Danish Edison, who, while experimenting with the telephone about 1900, discovered a new principle in electro-magnetism which solved the difficult problem of recording and reproducing sound. This principle is the localization of magnetism on a movable steel wire while passing through two small electro-magnets which are excited by some outside source.

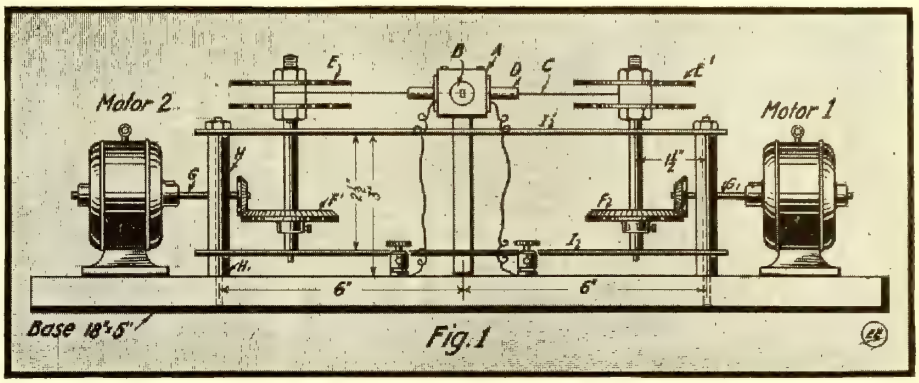
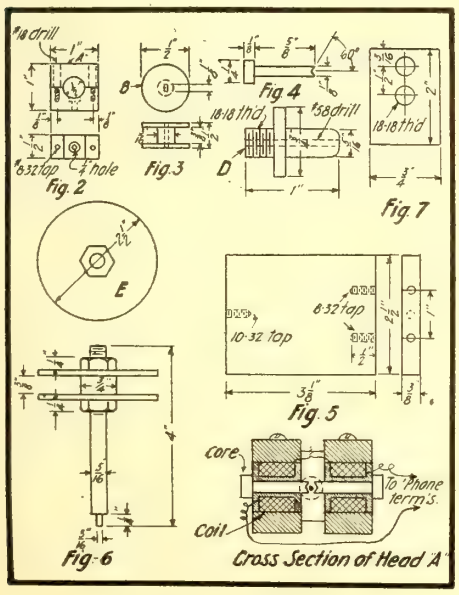


Fig. 1. The Telegraphone Which Can Record Telephonic or Telegraphic Signals on an Iron Wire.

The telegraphone here described was built by the writer especially for the purpose of recording radio-telegraphic and telephonic messages. The writer presents herewith a photograph of the finished telegraphone, and Fig. 1 is the drawing of all the principal parts and their relation to one another in the final assembly.

The details for constructing the individual parts of the telegraphone are given in the accompanying drawings. These do not require much description. By looking at Fig. 1 two aluminum plates I I¹, which constitute the supporting frame of the instrument, are fastened to a wooden base 18x5x¾ inches. These two plates are separated by brass washers H H¹ as shown.

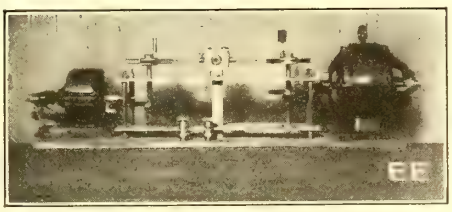
The talking and receiving "head" A consists of two small electro-magnets B B.



Details of Telegraphone.

supported by a suitable frame made of brass shown in Fig. 2. The two bobbins B B are made of hard rubber as shown in Fig. 3. These bobbins are then wound with 200 feet of No. 40 B. & S. gauge copper wire on each; care should be taken that the wire is wound evenly. The iron core, Fig. 4, is now to be made from soft sheet iron No. 18 gauge. The talking head supporter is made of brass or fiber, and details are shown in Fig. 5.

The two wire reels E E¹ are easily made from two aluminum discs 2½ inches in diameter and separated by a brass washer ¾ inch in diameter. These discs are held firmly on the shaft, Fig. 6, by two ¾-inch



Photograph of Completed Telegraphone.

brass nuts. A 2-inch beveled brass gear is now placed on each shaft as shown in Fig. 1. The wire guides D D are now made, and details of their construction are shown in Fig. 7. After each separate part has been completed, assemble them as shown in Fig. 1. Two small motors 1 and 2 are connected to the beveled gears F F¹ by two small miter pinions as shown. Now procure about 200 feet of 32 gage steel piano wire and wind it on one spool. One end of the wire is now passed through the guides D D and attached to the other reel.

The two electro-magnets B B are joined in series and connected to the receiving set in substitute for the usual telephone receivers. One of the motors is now started, and if there is any message in the ether the recording coils will record every sound on the moving steel wire. To reproduce these sounds it is necessary to unreel the wire in the opposite direction. This is done by running the opposite motor and unmeshing No. 1 motor gear. Now disconnect the telegraphone from the receiving set and connect a pair of phones to the talking head, and by listening in the receivers the operator will receive every signal that has been sent. High-speed messages may thus be copied on this instrument and reproduced very slowly, so that the unprofessional operator may read the same high-speed signals slowly just by running the motor slowly, etc. The ordinary speed of the wire is 10 feet per second.

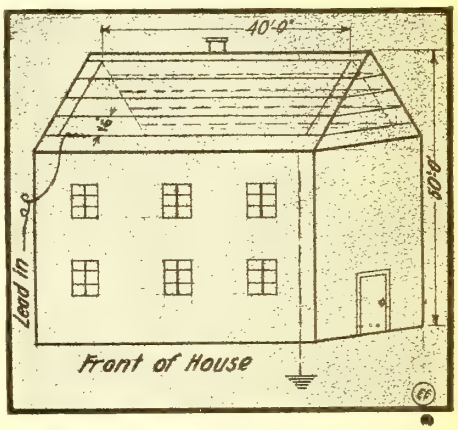
This telegraphone may be used excellently in connection with the ordinary line telephone. Telephone conversations and secret messages can be copied on this instrument just by connecting this instrument to the line wire in place of the usual receiver. It is hoped that this valuable instrument may be particularly advantageous to the experimenter who desires an instrument for recording radio signals.

The trans-Atlantic wireless stations in Germany have been heard clearly at the University of North Dakota, a distance of 4,300 miles.

SUCCESSFUL INDOOR AERIAL.

One of our readers, Raymond Schlegel, of Pittsburgh, Pa., has successfully used the form of indoor wireless aerial illustrated herewith. This arrangement consists of placing wire under the roof in the attic of the building and on both sides of the slanting roof structure. The wires are spaced about one and one-half feet apart and consist of No. 14 conductor. The highest wire in the aerial is about 50 feet above the ground. The length of the strands is 40 feet, there being nine wires in all.

They are all joined together at either end and, of course, insulators are placed in each strand. Mr. Schlegel has been able to pick up the wireless time signals from Arlington, Va., twice a day, at noon and in the evening at 10 o'clock, using a Ga-



Indoor Type Wireless Aerial. Efficient Under Wood, Slate or Tile Roofs.

lena or Silicon detector, with regular head 'phones, etc.

He states also that he can still read the time signals with this outfit with the head 'phones removed several inches from the cars. Metal-covered roofs are not as good in this case as tile covering, which obtains in this instance.

Have you voted? Do it now. See page 48.

WIRELESS ON THE MOTOR BOAT.

Now that the motor boat and yachting season is in full swing it is undoubtedly of great interest to many owners of such

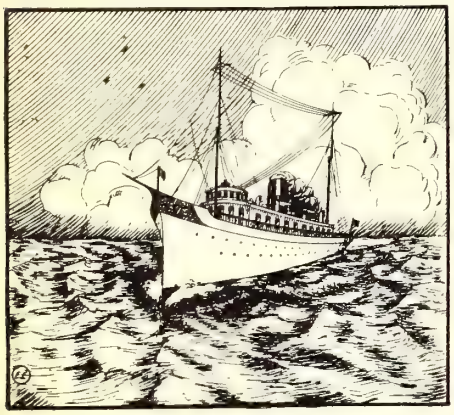


Fig. 1. Showing the Aerial on a Motor-Boat or Yacht.

craft to have a small wireless sending and receiving set on board in case of emergency, etc. It is surprising what an efficient outfit can be installed at very small cost nowadays.

The sketches and diagrams given herewith show how the set is best installed and assembled, on a hardwood or other switchboard preferably, so as to take up the minimum space possible.

Figure 1 shows the aerial arrangement for small motor boats, and it is best to have the foremast about 20 feet high at least. The small auxiliary rear mast should be nearly as high, if possible. The form of aerial shown has proven very efficient for such installations, and it may comprise four strands of phosphor-bronze cable spaced about 3 to 4 feet apart. The length of span between the spreaders will, of course, be governed by the size of the boat.

Regular antenna insulators should be used, of course, in each strand where they are fastened to the spreaders, and the lower section of the aerial should be tapered, so that all of the four or more strands are joined together to a No. 8 or larger copper conductor, passing through the lead-in tube or insulator L (see Fig. 2) placed in the roof or side wall of the cabin, as shown. It is well to place some sealing compound P over the end of the insulator L to keep water, etc., from running in during rainstorms, etc.

Regarding the radio set itself, this may be mounted exactly as the diagrams indicate and the transmitting set may comprise, for ordinary requirements, a storage battery of 6 to 8 volts, 3 to 4-inch spark coil S, Leyden jar or glass plate condenser C, tuning helix H, hot wire radiation ammeter W and throw-over aerial switch A, also key and spark gap M.

The receiving equipment may very well be selected to comprise a few high-grade and efficient instruments; such as a good-grade loose coupler B, mineral or other detector D, fixed condenser F, variable condenser K, pair of 2,000 or 3,000 ohm head phones T, together with necessary wire for connecting the various instruments.

The ground connection for such a station may be made in some cases through a No. 4 insulated copper wire G leading to the engine frame and the ground, thus established through the propeller shaft. In some cases the ground connection is made by connecting the wire G to a copper plate about 2 feet square, fastened on the outside of the hull, so that it is in thorough contact with the water.

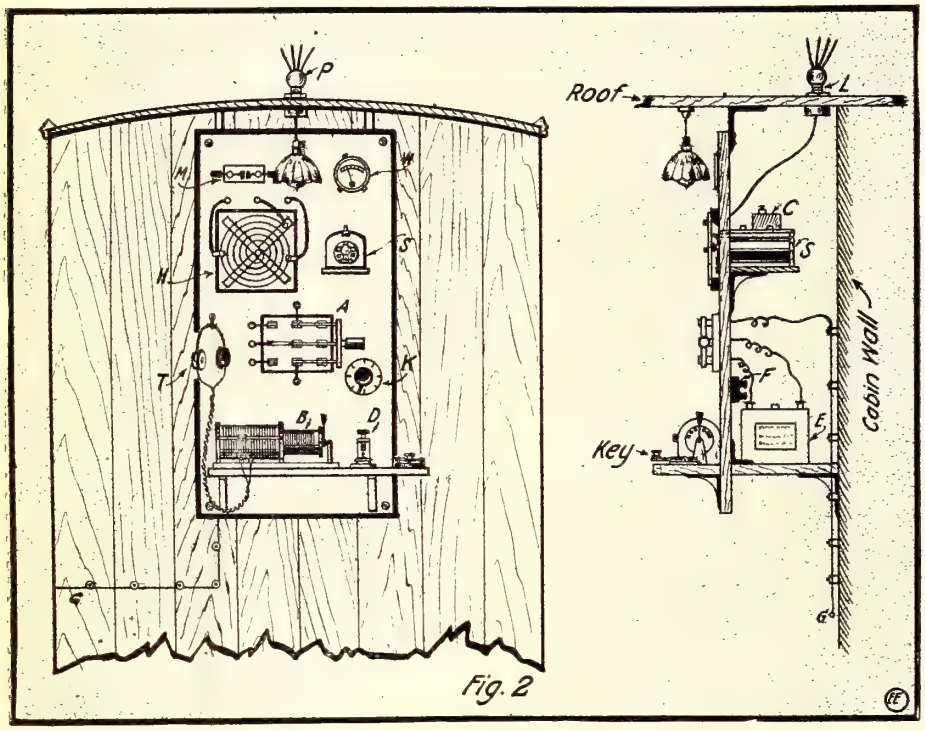


Fig. 2. Arrangement of Radio Apparatus in Cabin of Boat. Panel Style.

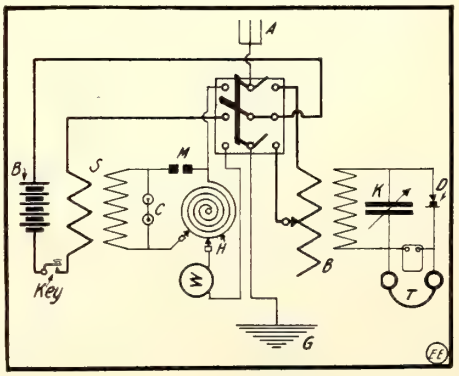
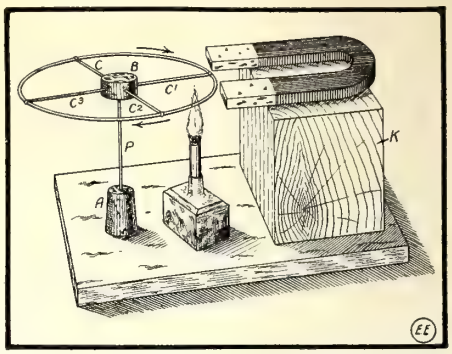


Fig. 3. Wiring Diagram of Boat Wireless Set.

At Fig. 3 is shown plainly the connections for this wireless outfit, and in transmitting the aerial switch A is closed in the proper manner and the signals are sent out, of course, in the telegraph code, which is usually now the Continental, by means of the telegraph key mounted on the front shelf of the switchboard. In tuning the receiving instruments the switches or sliders on the loose coupler are adjusted until the signals are received loudest. Also the variable condenser, if used, is moved until best results are obtained. It is best to use a regular buzzer test for adjusting the detector to its best condition. Further description is hardly necessary in this direction, as complete instructions and blue prints are invariably furnished with such an apparatus when purchased.

AN INTERESTING THERMO-ELECTRIC MOTOR.

The following brief description of a very simple thermo-electric motor will make it easy to build for the ordinary experiment-



Novel Motor Works by Heat and Magnetism.

er. The rim of the wheel is made from fairly thick iron wire and held by a cork B. The spokes C, C^1, C^2, C^3, are made of copper wire. The wheel is supported by a pin P and cork A. This cork is next glued to the base. A large steel horseshoe magnet is next supported on a block of wood K, near the wheel as shown. A small alcohol lamp is now placed under the rim of the wheel. As soon as that portion of the wheel becomes hot the wheel will begin to turn slowly, the heated portion turning away from the magnet—the reason being that, while iron is attracted by a magnet at ordinary temperatures, when the temperature is increased beyond a certain limit this partially ceases to be the case. But the cooler part is still subject to magnetic attraction, and the wheel is consequently kept on turning so as to bring such cooled portions in closer proximity to the poles of the steel magnet. The rim of the wheel should be not less than 3 to 4 inches in diameter.

HOW TO AMALGAMATE ZINC.

The chief difficulty one experiences in amalgamating zinc battery rods is in rubbing the metallic mercury into the surface. This difficulty can be obviated by using the following method: At first clean thoroughly the zinc from dirt and grease by dipping the zinc into a concentrated hydrochloric acid solution. The zinc is now placed for 10 minutes in a solution of bichloride of mercury. The bichloride of mercury will decompose and metallic mercury will unite with the zinc.

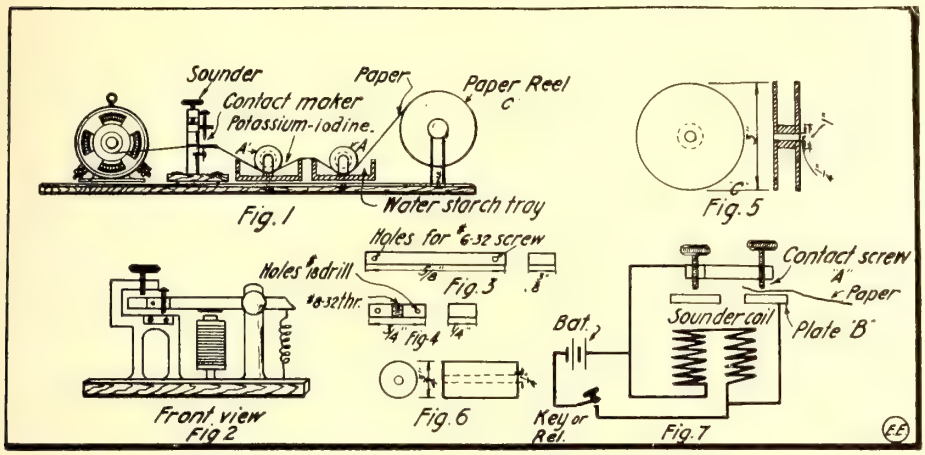
(Note.—Care should be taken in handling the bichloride of mercury as this salt is very corrosive on flesh and clothes. It is also very poisonous.)

AN INKLESS TELEGRAPH RECORDER.

By Samuel Cohen.

A UNIQUE, but practical, inkless recorder can be made by anyone, which will copy "code" without using a pen or pencil.

The following material will be needed



Ingenious Telegraphic Recorder Using Neither Pen Nor Pencil.

in constructing this inkless recorder: A small battery motor, one telegraph set, four binding posts, two feet of ¼x¼-inch brass rod, two rubber rollers, two small trays, one ounce of potassium iodide, four ounces of common starch, one rheostat, one S. P. S. T. switch; three inches of ¾-inch rubber rod, 1x1-foot brass sheeting 24 gauge.

First construct the contact point shown in Fig. 4, which consists of a rubber strip ¾x¼ inch and drilled as shown. This piece is then fastened to the lever of the sounder shown in Fig. 2. Then make the contact bed, which is made of ⅜x¼-inch brass rod; dimensions are shown in Fig. 3. After it has been made, it is then fitted on the sounder bracket (Fig. 2).

Two reels are then made of No. 18 gauge brass sheeting (Fig. 5). One reel is mounted on motor, and the other reel is mounted on a brass bracket ½x⅛x4 inches.

Two rubber rollers AA¹ (Fig. 1) are then made. These rollers are made of hard rubber (Fig. 6) and are mounted on brass standards 1½x½x½ inches.

Two 4x5 photograph developing trays are then mounted and clamped to the base as shown in Fig 1.

In the first tray A make a starch solution as follows: Dissolve four ounces of common potatoe starch, and in tray B dissolve four ounces of potassium iodide crystals in full tray of water.

After all the parts are made, arrange each part as shown in Fig. 1. Connect the contact point A and bed plate B as shown in Fig. 7. A rehostat and one S. P. S. T. switch is connected in series with the motor in order to regulate the speed of copying.

In operating this recorder properly, it is necessary that the speed of the motor is constant, or else the printing on the paper tape will not be regular.

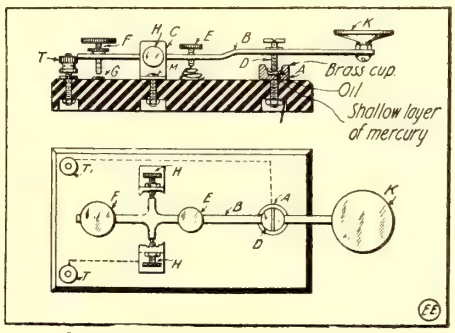
By regulating the speed of the motor and the current through the contact point by a second rheostat telegraph code has been copied as fast as 50 words per minute. The drawings are self-explanatory.

Remember: Storage batteries have to be charged from direct current. Use a rectifier on alternating current.

A MERCURY BREAK WIRELESS KEY.

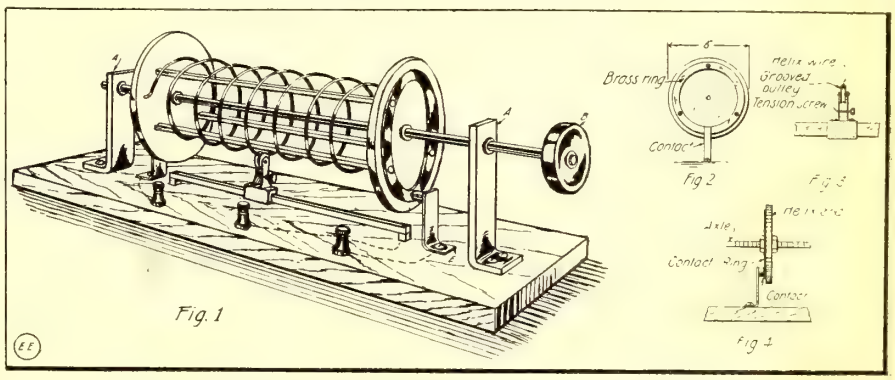
A good key for wireless transmitters is a necessity. It must be adjustable, the contacts of good size to carry heavy currents and, lastly, easily worked. The following key embodies all these good points:

The base, which is made of hard wood, may easily be procured. The size is left to the reader, that of the writer's being 6 x 3¼ x 1 in. Two holes are bored for T and T_1, the terminals. Some good, stiff brass strip is obtained and bent, as shown in figure, first drilling four holes, two on each side M_1 M_1, H and H_1; the screws



Wireless Key with Mercury Break.

M M_1 being to attach it to base and H and H_1 for pivots for the lever B. This lever, while of standard shape, is of heavier brass and longer than usual. Three holes are tapped in it for adjusting screws F, E and D. G is simply a metal rest for F. The function of F and E is apparent.



Efficient Design of Radio Helix Enabling Any Part of Coil to Be Used.

We now come to the contact device, A. This consists either of a carbon cup made from a dry-cell carbon or a brass cup, the latter is preferred. A *very* little mercury is placed in cup and covered with a little oil (olive oil will do, or even cylinder oil). The reason for the shallow mercury layer is that the tendency to "lag" will be reduced to a minimum. Then D is screwed down in the oil, so that it hardly touches the mercury. Then A is connected by a wire to T_1. For a better connection to other terminal, the spring at E may also be connected to it. K is a hard-rubber knob.

After a little practise, the adjustment may be improved so that no "lag" is detected and good satisfaction is enjoyed.

Contributed by H. C. GRAHAM.

A NEW TYPE SENDING HELIX.

A finely adjustable helix is an instrument that should be in every amateur's station, and here is one that does away with clips and loose wires.

A base is made, preferably of oak or mahogany, 24" long, 12" wide and 1" thick. Two end pieces, either round or square, should be made of the same material. If round they should be 8" in diameter, and if square, 8" by 8". In the center of each end piece a hole should be bored of ample size to admit the axle, which in turn should be threaded and provided with nuts to hold the end pieces in place.

Some No. 6 B. & S. aluminum helix wire should be procured and wound into a spiral 8" in diameter and 12" long with 1" space between turns; 3 spacing bars can be placed on frame as seen to support the wire if necessary.

Two rings are cut from sheet brass 8" O. D. by 6" I. D. by 1/16" thick. These are to be fastened on the end frame pieces by flat-headed screws passed thru countersunk holes. Get a battery bolt and file the end (the one with the screw driver notch in it) down flat, which is to be run thru the ring and end piece and fastened to the coil on the other side. The other end of the coil should be fastened to the other end piece in like manner.

The slider is made of ¼"x¼" I. D. brass tubing. Two pieces of spring brass or phosphor bronze are soldered to the top, one of which should be threaded and provided with a screw, and the other should have a hole bored in it of sufficient size to let the screw slip thru and screw into the other spring. The screw is used to regulate the grooved pulley action, as evident from Fig. 3. The slider rod is to be mounted about ¼" above the base and should be ¼" square and about 13" long.

In Fig. 1, C is a brass upright to keep the axle from slipping back and forth thru the bearings, A and A. B is a hard rubber knob fastened on the end of the axle to rotate coil.

I think the drawings will explain the rest, and the dimensions may vary to suit each builder.

By J. H. ALDEN.

Spectacular Discharges and Large Tesla Coils

To the uninitiated in electrical science there is probably no more entrancing and awe-inspiring effect to be seen than the spectacular display produced by the Tesla transformer. There are many acts traveling over the various theatre circuits which make use of the Tesla high frequency apparatus, and herein we will describe briefly how to construct one of these large 36" spark Tesla coils, together with necessary exciting transformer, auxiliary condenser and also spark gap.

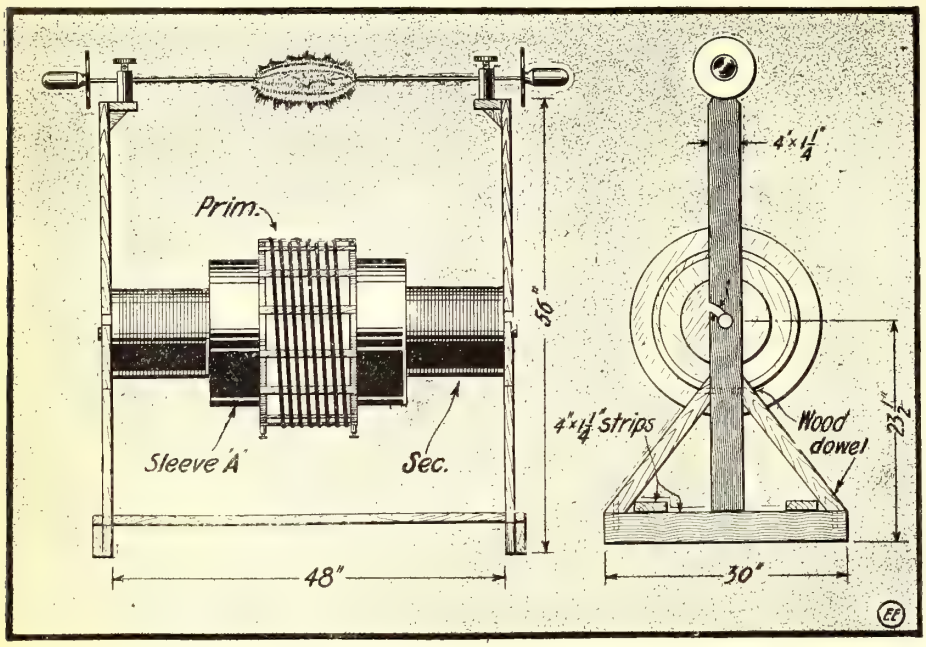


Fig. 2A. Appearance of Complete Tesla Coil for Use on 1 K. W. Transformer.

Referring to Fig. 1, the complete closed core type high voltage 1 kilowatt transformer is shown at A. As seen, the secondary and primary coils are wound each on one of the longer legs of the sheet iron core. The completed transformer may very well be mounted in a metal or lead lined wooden case, as shown at B, which is afterward filled with transit oil. The transformer is mounted on a couple of wood blocks, as indicated, placed inside the case.

Referring to details on this transformer, which is designed for operation on 110 volt, 60 cycle A. C. circuit, at a current of 9 to 10 amperes maximum, the dimensions and method of assembling the alternate layers of sheet iron strips are shown at C, Fig. 1. As seen, the individual strips, such as Nos. 1, 2, 3, 4, are staggered or lapped over the joints between the strips on the layer under it, as indicated by the dotted lines. In this way a solid core is easily built up and at either end suitable clamps made from a couple of pieces of iron or brass, with a couple of bolts, should be used to clamp it firmly together.

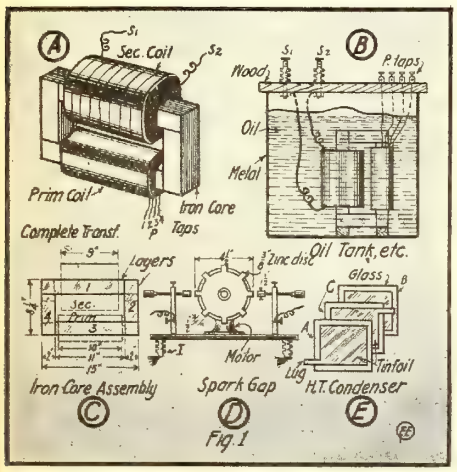


Fig. 1. Details of Step-Up Exciting Transformer, Condenser, and Spark Gap.

The transformer coils are best wound on wooden forms. The primary is 10" long and has on it 12 pounds, or 344 turns, of No. 10 B. & S. D. C. C. wire, with taps from the 250, 300, 344, and 1st turn for secondary voltage adjustment. Wrap several layers oiled linen around the primary core before slipping on the coil. Details on winding are given in any handbook on transformers.

The secondary comprises 11 pounds, or 50,000 turns, of No. 33 B. & S. enameled magnet wire, wound in 24 wax-impregnated pies or sections, each ¼" thick. Secondary then gives about 20,000 volts, with 250 primary turns in circuit. An adjustable choke coil like the primary in construction helps out the control nicely. The secondary core leg is to have 10-12 layers of oiled linen on it before the secondary pies are slipped over it.

The spark gap used for this 1 kilowatt high frequency generating outfit is probably best made of the rotary type, as shown at D, Fig. 1. This gap is composed of a zinc disc, about 4½" in diameter, having 8 to 10 projecting plugs cut on same as shown, to provide sparking points, as the disc is rotated by a suitable motor. This may be an ordinary fan motor. Two stationary spark electrodes are provided, as indicated, and the whole arrangement is best mounted on a marble or glass base. A piece of hard wood thoroughly boiled in hot wax may be utilized for the base.

Regarding the high voltage glass plate condenser for this outfit its arrangement is shown at E, Fig. 1. About .042 M. F. capacity is required in this condenser when the transformer delivers 20,000 volts, 60 cycle A. C., at the secondary terminals. If ordinary glass is used ⅛" thick, about 46 such plates measuring 12x14" are necessary, both sides of the plates being coated with heavy tinfoil 8x10", cut with a projecting connection lug as shown at E. When the condenser has been prepared it may be mounted in a cabinet suitably built and then filled with parafine or transit oil. The glass plates are placed one on top of the other in the final assembly, and there is only, of course, 1 tinfoil leaf between each plate. Every other tinfoil leaf connects to a common terminal, and in this way all the glass plates connected are charged and discharged when in circuit.

The dimensions for the large Tesla coil to be used with this outfit, capable of producing 30 to 36" high frequency sparks when all of the apparatus is properly tuned and adjusted, are given at Figs. 2 and 2A. This special large size, extra high voltage, high frequency air core transformer, is built at small cost and consists of a primary and secondary coil as usual, as well as an insulating sleeve A, ¾" thick, made of shellacked paper or oiled linen.

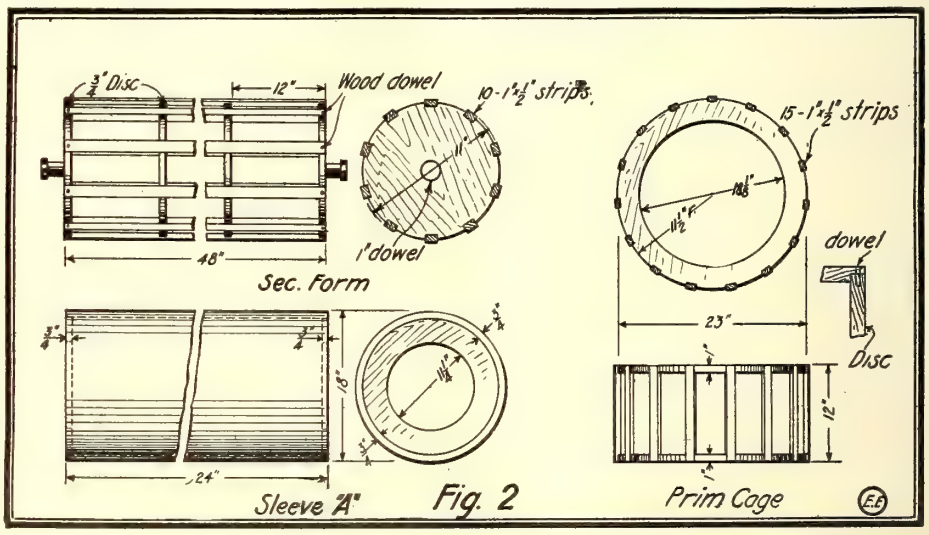


Fig. 2. Details of Large 36-Inch Spark Tesla Coil Parts.

The wooden framework for supporting the coils is indicated quite clearly in the drawing, and all of the wood parts are best boiled in hot wax. No metal parts, excepting the wire on the coils, should be used in constructing this transformer. The wood joints are readily held together securely by drilling ¼" holes and driving in same wooden dowel pins.

The secondary cage is made up of four

wood discs with 10 wood strips doweled fast to them as shown. The primary form is made in the form of a cage also, as indicated, of two wood rings and 15 wood strips, also held in place by wood dowels.

The primary of this large Telsa coil can be wound with 10 turns of No. 4 B. & S. bare copper, brass or aluminum wire spaced 1" between turns and the ends of the coil brought out to two binding posts. A substantial helix clip should be provided for one terminal of the primary circuit for adjustment. The secondary coil is wound with one layer No. 24 B. & S. enameled magnet wire, and each turn should be spaced apart the thickness of the wire by winding on a lathe, etc. Before winding the secondary coil the wooden cage may be covered with several layers of stiff paper or a layer of Bristol board. The layers of wire should be well shellacked.

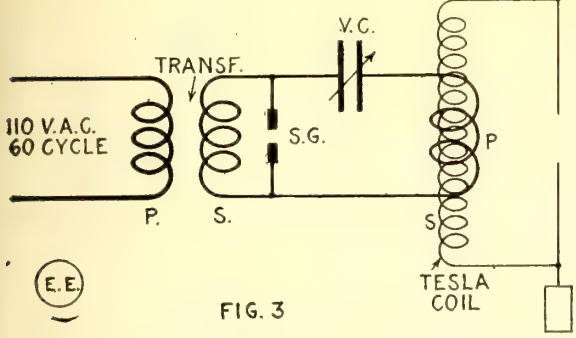


FIG. 3

Hook-Up of Large Tesla Coil and Exciting Transformer.

The connections for the complete outfit are shown at Fig. 3, where V. C. is the high voltage condenser arranged to be adjustable, and S. G. is the rotary spark gap. P. & S. are the primaries and secondaries, respectively, of the transformers. Tune the set for best results by altering the condenser plates on multiple and gap speed, the exciting transformer, and the Tesla primary turns in circuit. Use No. 6 wire or, better, copper ribbon for the high frequency connections.

FLUORESCENT WRITING.

If we dissolve some sulphate of quinine in water and then draw a design or write some motto or sentence on a piece of white paper with the solution and allow it to dry the drawing or design will be absolutely invisible. But if this same piece of paper be illuminated by the light of a Geissler or vacuum tube then the design or writing will at once appear as if written or drawn with a beautiful blue ink.

MARKING TOOLS WITH ACID.

The *American Machinist* recommends the following etching fluid for marking tools: Mix one part of muriatic acid, one of nitric and four parts of water. The tool is coated with wax and the design is then scratched in.

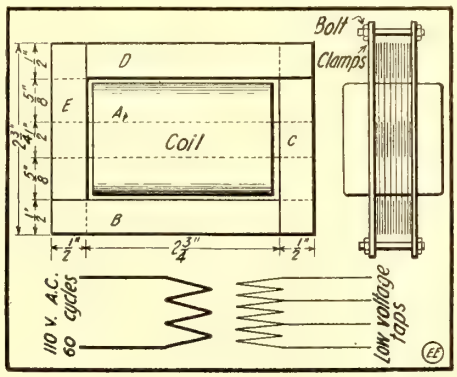
CONSTRUCTING A BELL-RINGING TRANSFORMER.

A small transformer, that can be used to operate bells, motors, etc., when supplied with 110 volts A. C., can be made very cheaply and saves the battery bill.

First construct the core, which consists of sheet iron strips. Cut up a pile of strips ½x3¼ inches for the middle leg A, and ¾-inch high when compressed. In a like manner cut up a pile with the dimensions ½x 3¾x¾ inches high, for two outside legs B and D. For the parts E and C cut up one pile only, ½x2¾x¾ inches high. The middle core A should be wound at first with five or six layers of heavy paper, and place over this a layer of friction tape. Now wind on one ounce of No. 34 enameled wire and wind it on the central portion as evenly as possible. The primary winding is then covered with several alternate layers of tape and shellacked paper.

The secondary winding consists of three sizes of insulated magnet wire, first, 100 turns of No. 22; second, 100 turns of No. 2, and third, 150 turns of No. 26. The ends of each winding are connected together, the end of the first to the beginning of the second, etc. This arrangement allows a final choice of three secondary voltages. The whole core should be arranged as shown in drawing. The core is held together by two clamps, one on each end. These clamps are made of strips of iron ⅛-inch thick, and are cut ½x3½ inches, four pieces being needed for the two clamps. One-eighth inch from each end a 3-16-inch hole is drilled. The core should be clamped in a vise and tightened up by the bolts on each end.

The transformer thus made may now be mounted in a suitable metal box filled with wax, and proper connections made as shown in diagram.



How a Bell-Ringing A. C. Transformer Is Made.

THE "GEAR" ROTARY SPARK GAP.

By S. Kruse.

The McCreary-Moore gear-gap is not as well known as its merits deserve. In the original design developed by Robert Moore an 80-tooth 16-pitch (5-inch diameter) brass gear, from which every second tooth has been removed, is mounted on the shaft of a "polishing head" B. The fiber or oak bar C carries two ½-inch brass rods or two large binding posts bushed up with washers, which in turn support the fixed electrodes of the form D.

It is of the utmost importance that the fixed electrodes be of the form indicated and that they be mounted on the frame and not on the base, to prevent vibration from the motor causing the electrodes to move.

The gear must be very carefully trued by mounting it on a shaft and then laying the shaft on a pair of straight-edges (rulers, saw-backs, etc.), and filing the rim of the heavy side till the gear will stay in any position.

The solid construction, good balance and comparatively low speed insure a wheel that is quiet and true-running to a hairline, while the shape of the parts gives a slow approach, yet a very sharp break.

The result is a tone equaled only by a 500-cycle synchronous gap.

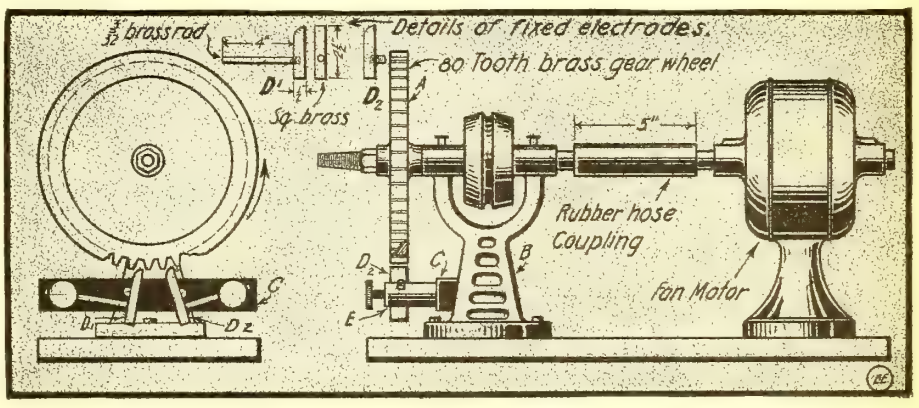
If a lower note is desired a Marconi tone may be obtained by removing 60 teeth and leaving 20. If preferred, a bicycle sprocket may be used, but it is hard to get perfect running unless a metal bushing is used.

The gap *must* be set as close as it will run—never over 1-20 inch—and will operate on as little as 100 watts. If more than 300 watts are employed a series-fixed or quenched gap may be employed to advantage.

When used as shown, direct-connected to a 12-inch induction fan motor, this gap is absolutely trouble-proof. A 60-cycle motor of this type runs at 1,750 r.p.m. on light loads, which gives (about) 1,200 and 600 sparks for the 40-tooth and 20-tooth wheels.

Where there is little "QRM" the 600 rate is better, but with much interference the high tone "cuts through" better.

In conclusion I will say that the gear-gap is universal in this region and that we have ranges which, for the power used, are second to none. My call is 9 LQ.



Unique Spark Gap Made from Gear Wheel Having Alternate Teeth Removed.

SUN SPOTS UPSET WIRELESS.

Unusual sun spot activity was reported recently by astronomers at Christian Brothers College, St. Louis, Mo. The wireless instruments at the college were greatly disturbed, and this is attributed to the sun spots. Nine spots were visible.

Litigation between the Marconi Wireless Telegraph Co. and the National Electric Signaling Co. has been settled by a license agreement by which the Marconi company secures the use of 171 Fessenden patents and in return grants the use of two basic tuning patents of Marconi and Lodge.

Uncle Sam's newest dreadnought is to be driven by powerful electric motors. Steam turbines drive the dynamos.

If you are not a subscriber don't fail to see page 38. If you don't we both lose.

WRINKLES — RECIPES — FORMULAS

Edited by S. GERNSBACK

Under this heading we will publish every month useful information in Mechanics, Electricity and Chemistry. We shall be pleased, of course, to have our readers send us any recipes, formulas, wrinkles, new ideas, etc., useful to the experimenter, which will be duly paid for, upon publication, if acceptable.

FORMULA No. 10.
Paints.

Proportions of Colors for Ordinary Paints:

White—100 parts of *White Lead.*

Black—100 parts of *Lampblack.*

Green—25 parts of *White Lead* and 75 parts of *Verdigris.*

Stone—99 parts of *White Lead* and 1 part *Burnt Umber.*

Lead—98 parts of *White Lead* and 2 parts of *Lampblack.*

Red—50 parts of *Red Lead* and 50 parts of *Red Ocher.*

Chocolate—4 parts of *Lampblack* and 95 parts of *Spanish Brown.*

Add the required quantity of *Raw Linseed Oil, Boiled Linseed Oil, Turpentine* and *Drier.*

For 20 lb. of paint take 2 lb. of *Raw Linseed Oil,* 2 lb. of *Boiled Linseed Oil,* ½ lb. of *Turpentine,* 1-10 lb. of *Drier.*

The proportions given must only be taken as an approximate guide when the materials are of good quality.

Anti-Corrosive Paint.—Take equal parts (by weight) of *Whiting* and *White Lead,* with half the quantity of *Fine Sand* or *Gravel,* with a sufficient quantity of *Color.* This paint can be used as a water color, but it is more durable to dry it in cakes or powder after mixing, and then use it as an oil paint by grinding it again in linseed oil. The proportions are: 12 parts of *Raw Linseed Oil;* 1 part *Boiled Linseed Oil* and 3 parts of *Sulphate of Lime* well mixed; 1 gal. of this prepared oil is used to 7 lb. of the powder.

Luminous Paint.—Mix together 40 parts of *Copal Varnish* (containing neither lead nor manganese, which would destroy the phosphorescence); 6 parts of prepared *Barium Sulphate;* 6 parts of prepared *Calcium Carbonate;* 12 parts of prepared *White Zinc Sulphite;* 36 parts of good *Luminous Calcium Sulphite* in a proper vessel to an emulsion and then grind it very fine in a color mill.

Phosphorescent Paint.—Heat *Strontium Thisulphate* for 15 minutes over a good Bunsen gas lamp, and then for 5 minutes over a blast lamp. Mix with pure *Melted Paraffin* for use as a paint for clock dials, etc., and expose for a time to sunlight.

Stencil Paint.—Take *Shellac,* 2 oz.; *Borax,* 2 oz.; *Water,* 25 oz.; *Gum Arabic,* 2 oz.; *Lampblack,* sufficient quantity. Boil the borax and shellac in water till they are dissolved; when the solution has become cold, complete 25 oz. with water and add lampblack enough to bring the preparation to a suitable consistence.

Innoxious Color for Painting Toys.—Mix 6 parts of *White Fine Chalk,* 3 parts of *Calcined Magnesia* (thoroughly calcined). Add a few drops of indigo solution. Oil, turpentine, driers as for any other paint.

White Paint for Metallic Surfaces.—Oil paints used on metallic surfaces exposed to heat frequently turn yellow. If, instead of oil, *Sodium Silicate* be used, no change of color will be noticed.

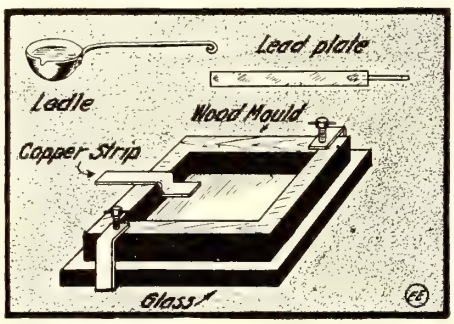
Marine Paint.—For metals in salt water: 44 parts of *Red Lead,* 24 parts of *Quicksilver,* 5½ parts of *Thick Turpentine.* Mix to proper consistency with boiled linseed oil. Grind the turpentine and quicksilver together. Then grind this mixture with the red lead and add the linseed oil. Use as little oil as is necessary to make the paint lay on well. To make the Marine Paint adhere firmly, use first a coat of *Oxide of Iron.*

A REMARKABLE PRIMARY BATTERY.

The primary cell with which we are all familiar has one bad feature, viz., polarization. To overcome this trouble, due to using metal electrodes such as zinc, which allow the electrolyte solution to carry zinc salts to the surface of the opposite electrode, of copper, say, one of the most ingenious improvements in a long time has been made by E. Bellini.

His method is quite radical in primary battery design, and instead of employing zinc for the negative electrode he has utilized a cast-lead plate having a slight amount of mercury in it.

In Mr. Bellini's battery the negative electrode is formed of an amalgam of lead, formed by pouring mercury into the molten lead. A suitable proportion is to take one part by weight of mercury and nine parts by weight of lead. The positive electrode is a carbon sheet. The electrolyte is a mixture of sulphuric and nitric acids. A suitable proportion for the solution has been found by mixing a litre of water with 80 cubic cm. of sulphuric acid



Showing Mould for Casting New Mercury and Lead Battery Plates.

of 66 deg. Baumé and 120 cubic cm. of nitric acid of 36 deg. Baumé. The E. M. F. of this battery will be found to be 1.25 volts. During the working of the battery a white, flocculent and heavy substance falls from the negative electrode to the bottom of the cell. This substance is formed of lead sulphate, mercurous sulphate and of little globules of metallic mercury. Gas is given off from the positive electrode, and this is found to consist of the products of decomposition of nitric acid.

In the illustration is depicted a simple scheme for casting these special lead amalgam plates. A wood block is mortised out as seen and is backed up by a slate or other smooth plate. Clamps or weights hold the two together. A little fire clay or putty may be placed around the outside seam of the slate and wood. For connection a copper strip is bent as shown and placed in the mold so as to be cast in the plate. The molten lead amalgam is poured into the mould and soon becomes solidified. The slight amount of mercury is added to the hot lead before pouring. The plate can be about ⅛ to $\frac{3}{16}$ inch thick.

The battery used for the author's test in finding the rate of discharge was formed of four positive plates, placed alternately with three negative or lead amalgam plates. The total active surface of negative electrode was 900 square cm., and of the positive 1,230 square cm. The mean distance between the electrodes was 2 cm. The total amount of electrolyte was 2.6 litres. The internal resistance was 0.022 ohm for a rate of discharge of 5 amperes. The capacity was found to be 112.5 ampere-hours. At the end of the 24 hours there was added 450 cubic cm. of water, 96 cubic cm. of sulphuric acid of 66 degrees B, and 192 cubic cm. of nitric acid of 36 deg. B.; the test was then continued for a further period of 14 hours. The capacity was 63 ampere-hours. The same amount of electrolyte was then added again, and the battery was then discharged for 27 hours, with an interval of rest of 11 hours in the middle of the test, the capacity being in the last case 115 ampere-hours.

The consumption of the amalgam on open circuit is very small, and to all intents and purposes nil, provided the surface of the electrode is clean and free from any foreign substance which might give rise to local couples. The consumption of the amalgam on closed circuit is about 5 grammes per ampere-hour. This battery seems to have considerable merit indeed.

BOOK REVIEW.

"Oxy-Acetylene Welding and Cutting." By Calvin F. Swingle, M.E. 200 pages. 76 illustrations. Size 4½x6¾ inches. Published by Frederick J. Drake & Co., Chicago, Ill. $1.00. Cloth.

A timely treatise written in easily understood fashion on the operation and care of acetylene generating plants; also the removal of carbon by the oxygen process. The illustrations are very clear, making the matter easily interpreted to the layman. The subject starts off with welding, oxygen and its properties, acetylene and acetylene generators, etc.

Practical instructions are cited throughout the book in regard to the best way to burn steel beams in half, cutting off pipes, boilers, and other details of interest to the oxy-acetylene operator and lay reader alike.

"Drake's Telephone Handbook." By David Penn Moreton, B.S., E.E., Associate Professor of Electrical Engineering, Armour Institute of Technology. Pocket size, 4½x7 inches. Cloth covers. 285 pages, 161 illustrations. Price, $1. Frederick J. Drake & Co., Chicago, Ill.

A new book on practical telephone matters by Professor Moreton, and written in his easily understood style, suitably illustrated. The first part of the book takes up the fundamentals of electricity rather briefly, but this is made up for by the excellent and complete digest of up-to-date telephone systems. One chapter deals with the physics of sound as related to telephone matters, and then follows magnet systems, common battery systems, the construction of telephone lines, with span, tables, etc., while the book finishes with a complete index to all ordinary telephone line and instrument troubles.

The section on common battery systems is modern and covers the Bell and Western Electric circuits, which are clearly explained, so that anyone can soon grasp the principles involved in making a connection through a central battery exchange. Moreover, all of the standard apparatus is mentioned in diagrams, such as P. B. X. exchanges, with W. E. Co. equipment, including type number, etc., as 10 ohm 118-A.P. relays, 8-P retard coil, 87-A relay, et cetera. Undoubtedly this book, especially at the price, will have a large sale among those interested in the actual working details of modern telephone systems.

The Fessenden Radio Station at Brooklyn, N. Y.

The National Electric Signaling Co., exploiting the wireless patents and inventions of Prof. Reginald A. Fessenden, formerly special scientist in wireless research for the United States Government, and now the inventor of the new submarine signal, has a very fine radio plant at Brooklyn.

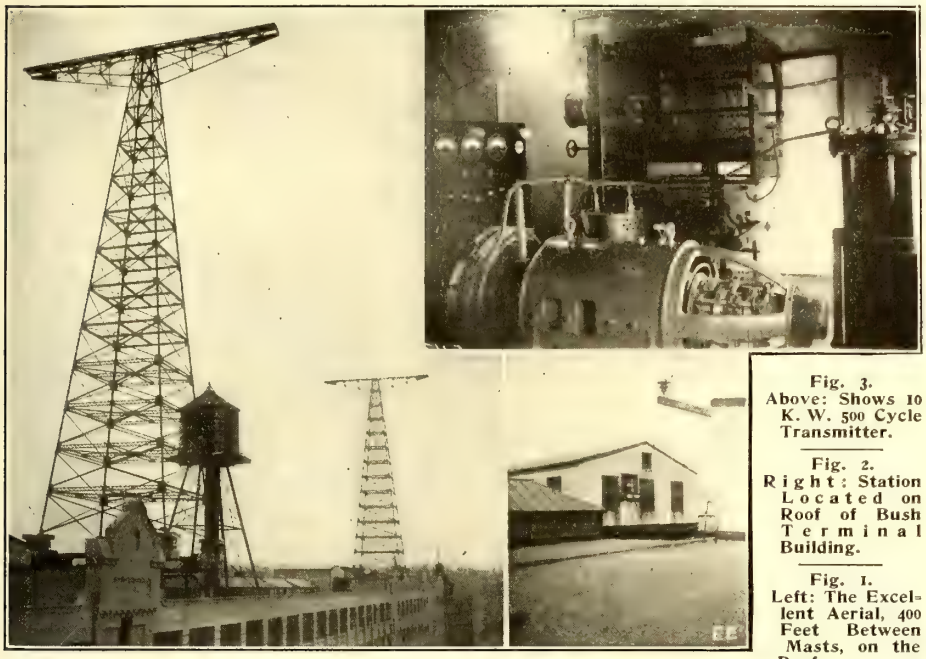


Fig. 3. Above: Shows 10 K. W. 500 Cycle Transmitter.

Fig. 2. Right: Station Located on Roof of Bush Terminal Building.

Fig. 1. Left: The Excellent Aerial, 400 Feet Between Masts, on the Roof.

The photographs here shown illustrate the mighty steel aerial towers, also station and apparatus of its plant located at the Bush Terminal, Brooklyn, N. Y. On the roof of the six-story concrete building, in which the plant is located, two gigantic latticed steel masts are erected, which are seen in the photograph.

These towers (Fig. 1) are substantially constructed to withstand a heavy gale. The aerial span is about 400 feet and the height of each tower is 150 feet. The towers are insulated from their supporting surface on the roof by a concrete foundation and conical porcelain foot insulators about 2 feet high. The cross-arms, or spreaders, at the top of the towers, are about 40 feet long and support 15 phosphor bronze aerial cables.

The lead-in (Fig. 2) is brought to a lightning grounding switch outside of the station and another wire is led into the station, where it is connected to a regular antenna switch.

The station has a high frequency alternator, which is capable of delivering an alternating current with a frequency of 200,000 cycles per second. This high frequency alternator is driven at an enormous velocity, the speed often being as high at 30,000 revolutions per minute. It is driven by a De Laval steam turbine, in which the shaft runs at 25,000 to 30,000 R. P. M. The alternator delivers an output of 2 K. W.

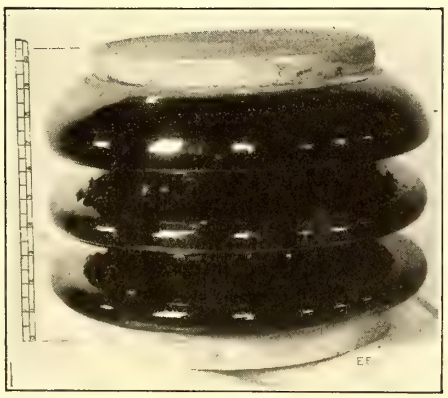
The regular 10 K. W. transmitting apparatus is shown in photograph (Fig. 3). This generator is seen in the foreground. The condensers are located at the extreme right in the photo and are of the compressed air type. The oscillation transformer is located on the rear of the transmitting panel and is discerned at the center of the photograph.

The inductance of the oscillation transformer is regulated by means of a handle in front of the panel below one of the meters as perceived. Remarkable results have been obtained with this 500 cycle set. Signals have been transmitted in daylight to Galveston, Tex., without any trouble, which is quite remarkable from the standpoint of efficiency.

The receiving set consists of the standard Fessenden type heterodyne receiver, operating upon the "beat" principle, thus realizing an amplification value of considerable power. Messages are daily copied from Nauen, Germany; Honolulu, etc. Illustrations through courtesy of Mr. Kroger, chief engineer.

MASSIVE INSULATORS FOR RADIO TOWERS.

The object of the extremely large porcelain supporting insulator here shown is to provide an insulated base for support and insulation of large electric conductors, and especially for currents at ultra-high voltages.



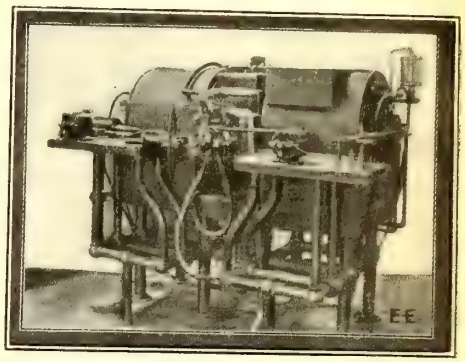
Massive Radio Mast Foot Insulator.

The insulators are manufactured by the wet process method, and stand 10½" high and are provided with corrugations or petticoats to increase the creepage distance and give a sheltered or dry surface under rain or storm conditions, the top and bottom of the insulator being provided with metal castings for mounting purposes. The total weight of the individual insulator is 120 lbs., including the metal parts. This design of insulator is capable of supporting a load of 500,000 lbs. and has an ultimate strength of 1,150,000 lbs.

This class of insulator is being used by the United States Government at its wireless stations at Panama, Balboa, San Diego, Cal., Honolulu in the Hawaiian Islands, Tutuila in the Samoan group, Guam and still another at Manila in the Philippines.

OVER 4,000 MILES BY WIRELESS ARC.

The Poulsen arc rated at 100 kilowatts and the long-distance work accomplished by its use in signaling from San Francisco to Honolulu and from Tuckerton to Honolulu (a distance of 4,330 miles) was featured in an excellent paper by L. C. Fuller, of the Federal Telegraph Co., at the April meeting of the American Institute of Electrical Engineers, New York.



Type of 100 K. W. Poulsen Arc Used to Signal 4,330 Miles.

It was a joint meeting of the American Institute of Electrical Engineers and the Institute of Radio Engineers. The Austin radio-transmission formula was checked in these tests by Mr. Fuller and fairly well substantiated for distances up to 4,330 miles, and this work should indeed be of great value to the radio profession engaged in designing long-distance apparatus. Wave lengths up to 11,000 meters were used. At 10,000 meters, using the 100-K.W. arc at Tuckerton, N. J., a daylight current of 5½ micro-amperes (5½-millionths of an ampere) was received The tikker was employed. The Goldschmidt alternator and the arc appear to give equally good results. Prof. Zenneck, of Germany, took part in the discussion, as well as several others of prominence in radio circles.

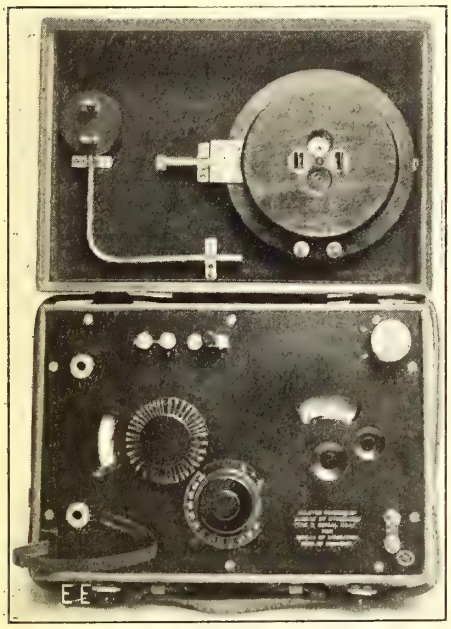
INSTITUTE OF RADIO ENGINEERS MEETING.

The monthly meeting of the Institute was held on Wednesday evening, May 5, in Fayerweather Hall, Columbia University, New York city.

A paper by Mr. Benjamin Liebowitz was presented on "The Pupin Theory of Asymmetrical Rotors in Unidirectional Fields, with Special Reference to the Theory of the Goldschmidt Alternator." This paper dealt with the theory of the Goldschmidt alternator in particular, as developed by Prof. Pupin and contains some interesting conclusions.

THE KOLSTER RADIO DECREMETER.

In radiotelegraphic circuits, the decay of the current surges is very important. Technically, it is known as the logarithmic



New Kolster Radio Decremeter.

decrement. This factor is stipulated by the United States statutes governing radio stations to be of 2/10 or less in magnitude. To furnish a quick and easily manipulated instrument for the purpose, the instrument shown was perfected by F. A. Kolster, of the Bureau of Standards.

It comprises interlocking condenser knobs, buzzer, hot wire meter, extra loading condenser, and exploring inductance coils, which latter may be seen resting in the lid of the cabinet. This instrument permits of all necessary wave measurements and is widely employed by the Government radio inspectors.

H. A. MERKEL HAS RADIO STATION.

H. A. Merkel, a telegraph operator at Lyons Station, Pa., and living south of Fleetwood, is spending his spare time on his wireless telegraph. He has made extensive improvements to his apparatus, his aerial with his old arrangement having had considerable difficulty to read ships at sea and land stations over 600 miles away.

Mr. Merkel has now erected a mast 85 feet high and has lengthened the aerial to 130 feet, whereby he expects to have results that will liberally pay for his extra outlay of work and money. It has attracted hundreds of people in this vicinity, and the visitors find Mr. Merkel always ready to give them a thoro demonstration of his wireless.

WIRELESS IN THE POLICE BARRACKS.

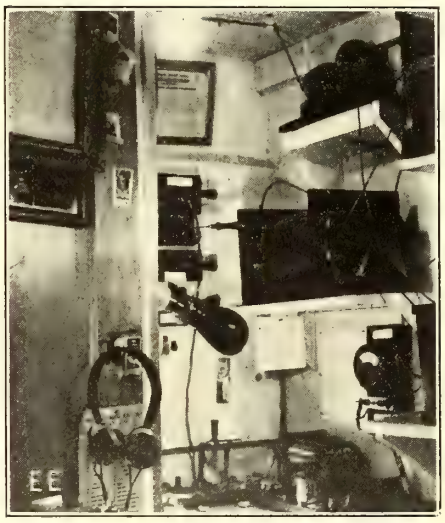
By Frank C. Perkins.

The accompanying illustration shows a novel wireless equipment in the Pennsylvania State Police Barracks at Pottsville, Pa. The sending apparatus consists of a Blitzen transformer, a condenser, oscillation transformer, rotary gap and hot wire ammeter arranged as shown in the photograph.

The receiving set includes what is termed a Radion receiving set, with loose coupler or transformer, Universal detector using Ferron crystal, fixed condenser, rotary variable condenser and two double telephone head sets with all wiring, including the Blitzen duplex loading coil and switch having a range of wave lengths covering all stations in the United States, all mounted on a mahogany base.

It may be stated that the aerial consists of four wires suspended in the air 75 to 100 feet, composed of phosphor bronze cable 50 feet long on top of the barracks, which is a three-story building. The lead wires from the aerial comes in separate to four double-throw single-pole switches. With proper manipulation of the switches the operator is able to receive and send on any desired wave length, the aerial being bridged at one end with wires one and two connected together. Two and three aerial leads connected by a single pole switch near aerial leads to instruments make it possible to use only two wires for receiving or four, or making the entire length of the wires one single wire by bridging the two other wires three and four at other end of aerial.

It is of interest to note that the ground wire is connected to the city water mains, besides several copper wires laid in the earth several feet deep under the aerial and all connected together. The joints are soldered throughout the entire plant. From this wireless plant all the commercial stations have been heard within a radius of several hundred miles, including Key West and the station at Guantanamo, Cuba, besides all the stations using from 175 meters up. This station is rated at one kilo-



Wireless Used by Police Department, at Pottsville, Pa.

watt and has a sending radius of about 75 to 100 miles. The operator is Cotesworth M. Jackson, of the Pennsylvania State police force.

EFFECT OF THE EARTH IN RADIO TELEGRAPHY?

Prof. J. A. Fleming delivered an address on "The Function of the Earth in Radio Telegraphy" before the Wireless Society of London, recently.

It was an undoubted fact, he said, that the nature of the earth's surface exerted a most important effect on wireless transmission over it. In certain districts there was quite abnormal wave attenuation as, for instance, north and northeast of Newport, R. I. (U. S. A.), in the district where Dr. Austin's experiments were carried out between Brant Rock and the Cruiser "Birmingham."

Assuming standard physical properties, the depth of the "current skin" in the copper was about ¼ mm., but in iron it was only 1/50 mm., owing to the high permeability of this metal. By means of striking cymometer experiments, Prof. Fleming showed that while insulating coverings did not affect the damping produced by the magnetic properties of iron, galvanizing provided a skin of zinc thick enough to carry the high-frequency current without permitting the latter to reach the iron core. Galvanized iron wire was, therefore, permissible for aerials and for earth connections so long as the galvanizing remained continuous and uncorroded.

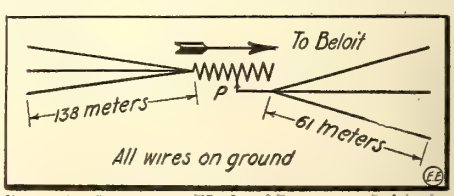
The materials of the earth's crust were conducting dielectrics, and the problem of the current penetration was complicated by the fact that conducted current and dielectric current had both to be taken into account. The conductivity of all dielectric materials, even if imperfect dielectrics, was much greater for alternating than for direct currents and was vastly greater still when carrying currents of radio-telegraphic frequency. There was, he said, a fertile field for research in measuring the conductivity and dielectric constants of the sea water and earth crust materials at radio-telegraphic frequencies, and particularly valuable results might be expected from really large scale experiments say, with huge electrodes one-quarter mile or so apart, which would give reliable averages for various kinds of soil under various conditions.

Prof. Fleming showed mathematically that refraction of electrostatic fields between air and earth or water produced a considerable horizontal component near the surface, thus producing a periodic displacement or wave in the earth's crust. To this prenomenon the speaker attributed the possibility of reception of time signals on such unorthodox aerials as bedsteads, bicycles and dustbins.

Though much yet remained to be learned, it was definitely established that good conductors prevented deep current penetration; that penetration and attenuation occurred apart from mere weakening by diffusion; that attenuation was greater for short than for long waves, and reached a maximum at certain values of permeability, resistance and dielectric constant; and that the curvature of the earth weakened the true space wave. At 3,000 to 6,000 miles, most of the received effect was probably due to bending by ionic refraction. Long-distance reception was complicated by many factors, and our earth was probably unique in being the only planet on which long-distance radio-telegraphy was possible.

RADIO ANTENNAE ON GROUND.

A number of interesting tests on radio antennæ, composed of magnet wire resting on the ground are described in the *Elec-*



Arrangement of Ground Aerial.

trical World for March 20, 1915; Stations 600 kilometers away were clearly read.

As a result of the experiments several facts stand out more or less clearly. In the first place, so far as we know, this is the first time in this country that electric waves have been successfully received over

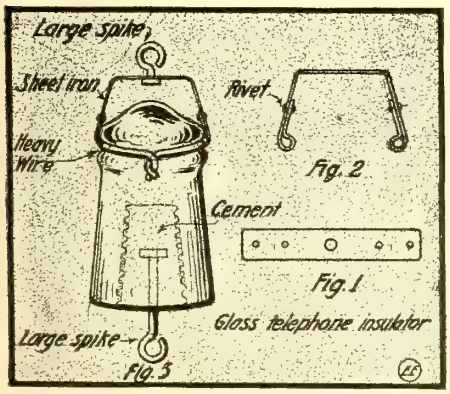
commercial distances by using a single bare wire placed directly on the ground, say the authors. Further, it is apparent that a somewhat symmetrical multiple earth-wire system may be used for receiving in practical radio communication, without necessitating any increase in sending power over that employed when utilizing ordinary elevated antennae. It is also evident that such single or multiple earth-wire systems possess a directive effect, and that the elements which extend away from the transmitting station are the most important in this respect.

When used as an absorber, insulation of the wires apparently plays a very minor part. The best system evolved is shown in diagram; the multiple wires being joined to a loose coupler primary, P, situated 61 meters from the end, pointing toward Beloit, where the transmitter was located.

Magnetic coils for high frequency or wireless circuits contain no iron, as the current changes from positive to negative so fast, the iron cannot magnetize and demagnetize fast enough, giving rise to high hysteresis loss, as it is called. As high frequency alternators work at 100,000 cycles with iron cores, it is peculiar that inductance coils cannot have iron cores, and thus raise their efficiency.

HOW TO MAKE STRAIN INSULATORS.

Very good insulators for wireless aerials, etc., may be easily made from ordinary telephone insulators. First select good, sound insulators, and for each cut a sheet metal strap about one-inch wide and long enough so that after it is shaped (like shown in Fig. 2) the loops at each end will fit into the wire channel of the insulator. The loops at the end are first riveted, and then a hole is drilled in the center and a large spike inserted which is formed into a hook as shown. Hook the loops in the wire channel of the insulator and draw a heavy wire through the loops and around the insulator, then twist the ends quite tight. Make another hook from a large spike and with some cement imbed the head end of the spike in the hollow end of the insulator, as shown in Fig. 3. I am using these insulators in my wireless aerial with very good results. They will



Strain Insulator Made of Glass and Cement.

stand considerable strain and quite high voltage without breaking, besides being very cheaply constructed.

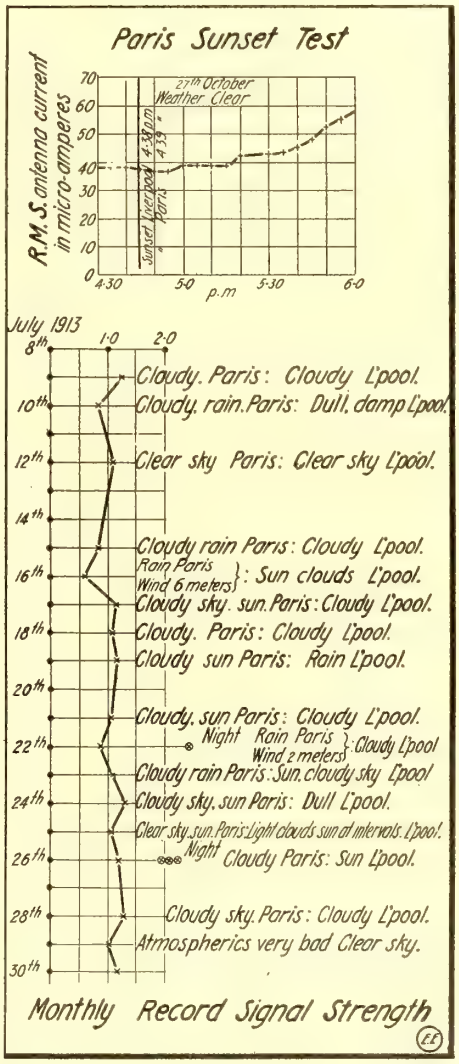
Contributed by
FRANK HAVERLAND, JR.

Do you know that "movie" machines consume very often as much as four to five horsepower?

VARIATION OF STRENGTH OF RADIO SIGNALS.

In a paper by Prof. E. W. Marchant, D.Sc., in *The Electrician*, London, for Feb. 12, 1915, much interesting data, together with curves, is given on the conditions affecting the variations in strength of wireless signals, covering a considerable period.

One of the earliest observations in connection with wireless telegraphy was that it was possible to transmit over much longer distances by night than by day, and it has been a matter of discussion ever since as to what is the cause of that variation. Several observations have been made at the time of sunset, covering the "sunset effect," and part of the results are recorded in figure. The first point which deserves notice is that the increase in



Graphical Chart of Variation in Strength of Radio Signals.

strength of the signal does not occur at the time of sunset, but some time afterward. This is what might have been expected if the state of ionization of the atmosphere is the controlling factor in determining the signal strength. The increase in signal strength occurs at almost the same time as daylight ceases, i. e., at the same time as the number of ions per cubic centimeter in the atmosphere would rapidly diminish.

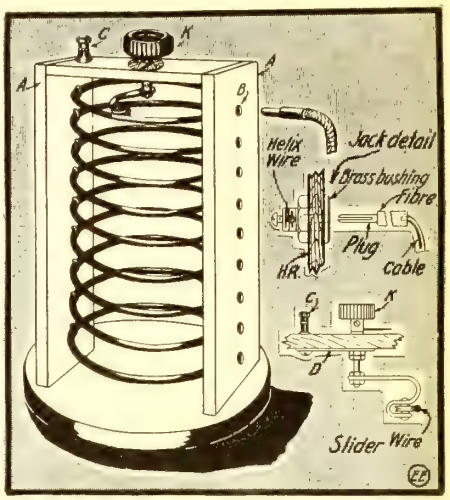
The curves presented, however, indicate that the sunset effect varies with the weather conditions at the time of sunset.

The day strength of the signals varies within comparatively narrow limits, but the average strength of the signals during June and July is noticeably less than that during December and January. The lower curve shows the variation for one month, day by day, in strength of signals.

The variations in strength of signal from day to day are comparatively slight, but they are noticeably greater for March and July than they are for December and January.

A COMMERCIAL TYPE HELIX.

The wireless sending helix in most amateur stations is generally a cheap affair and oftentimes it is very inconvenient to use. An idea is here given which follows some-



Commercial Style Helix for the Amateur.

what the design of several commercial helices and loading coils for transmitting purposes. In making this design it is best to construct the two uprights A and the top cross-piece, of hard rubber or some well-dried hardwood thoroughly boiled in wax.

Eight to twelve turns may be used in the helix, about 6 inches in diameter, and spacing them ⅝ to ¾ inch apart. The wire may be about No. 6 B. & S. for small sets and of aluminum, brass or copper. Contact with one side of the circuit to any number of any complete turns is given by means of a jackboard B, detail of the construction of same being given in the sketch. By arranging a rotary knob and contact arm with wheel for the top turn, it is possible to quickly make conection with any part of one turn, as will be evident. The top turn of wire should, therefore, be made practically horizontal as regards all parts of the turn, so that the wheel will follow around same quite truly.

The jackboard and receptacle for same may be purchased from any telephone supply company, or they can be made up by the experimenter who happens to have a lathe at hand. A wax impregnated wood base may be used for the helix, etc. The other side of the circuit is connected to the rotating arm K, through a brass strip D and post C.

L. Hildebrand, of Denver, Colorado, writes us:

"I take your *'Electrical Experimenter'* and I sure think it is a dandy paper. I don't believe I could do without it."

"Your November issue of the *'Electrical Experimenter'* was the first that I have seen and I am very pleased to find it such a fine magazine. I buy about six different electrical and mechanical magazines a month, and I think this is one of the best ones published for the young Experimenters."

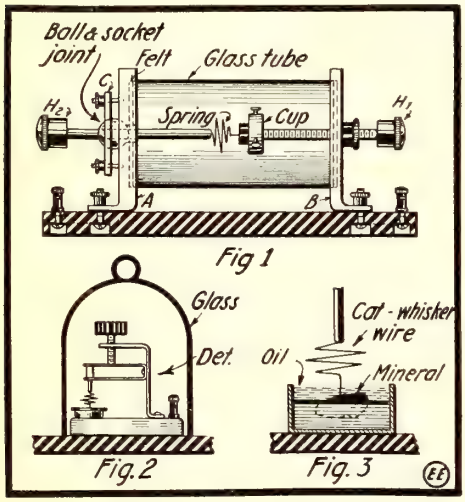
IMPROVEMENTS ON DETECTORS.

Of all the amateur wireless detectors in use to-day probably not 3 per cent. are properly covered up to protect the crystals against dampness and dust in the air. The best detectors are generally covered by a glass shell in some way, such as Fig. 1 shows. Here a threaded brass rod and handle H_1 pass through a threaded hole in the upright B. This rod carries a cup to hold the crystal, and also is tapped and fitted with three thumbscrews to clamp it with. The glass tube or cover is secured in place between the metal uprights A and B, in felt-lined grooves turned in them, as will be seen.

The cat-whisker wire, in the form of a spiral preferably, is carried on an arm H_2 which fits snugly but not tightly in a ball clamped under a bar C and two thumbnuts. The ball can be split on one side if desired, to clamp the rod more tightly whenever the bar C is tightened up. Thus the rod H_2 can slide lengthwise through the ball and around any angle over the face of the crystal owing to the ball and socket joint formed. The base should be nothing but glass, hard rubber, fiber or marble for highest efficiency. Molded composition is all right also.

At Fig. 2 is seen the easiest manner in which to cover over your detector to keep the dust out. A glass laboratory or watchmaker's bell is placed over it. It may be arranged in a wooden frame and hinges, so it can be tipped back, permitting of quick accessibility to the detector for readjustment.

It is well to cover the mineral with oil, as depicted at Fig. 3, to keep the crystal in first-class shape. Paraffine or other oil can be used.



Three Methods of Improving Detectors.

THE SENSITIVITY OF THE TELEPHONE RECEIVER.

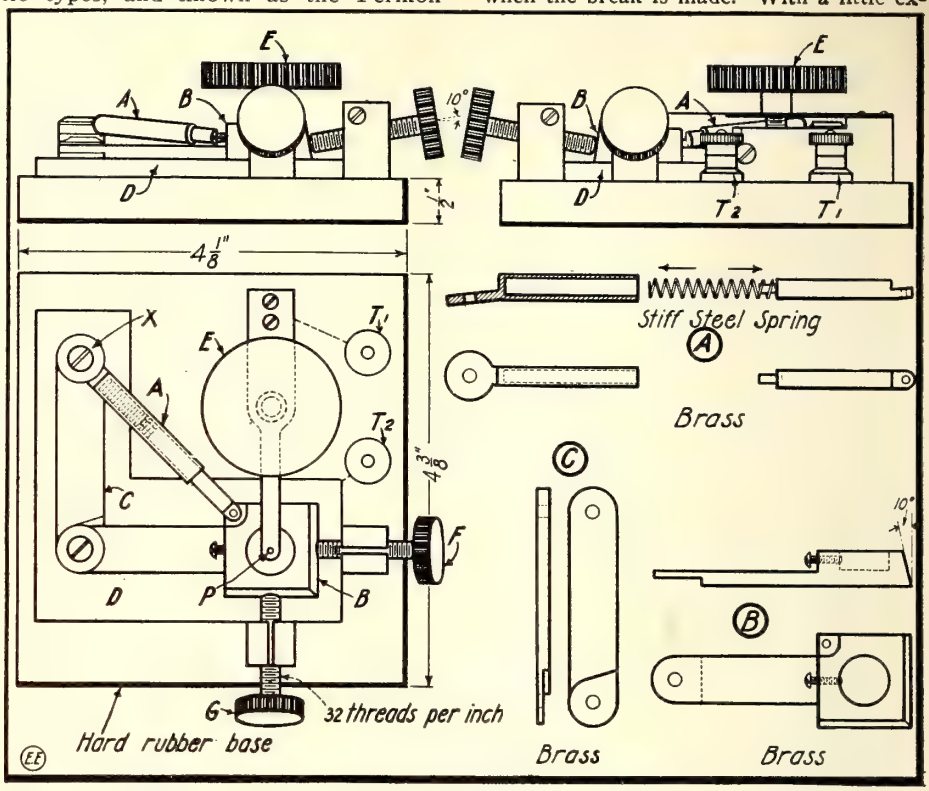
It is truly marvelous how sensitive an ordinary telephone receiver is. Preece calculates that a sound is produced in a telephone by current equal to .000,000,000,000,6 (six ten-trillionths) of an ampere in intensity, or such a current as could deposit about .000,000,000,000,03 (three hundred-trillionths of a cubic inch of pure copper in each second of time.

Pellatt calculates that with a voltage of .0005, representing the difference in potential between the two terminals, an audible sound is maintained in the receiver.

Above values may be multiplied by 10 to 25 times if the instrument is a modern wireless telephone receiver.

THE PERIKON-ELECTRA DETECTOR.

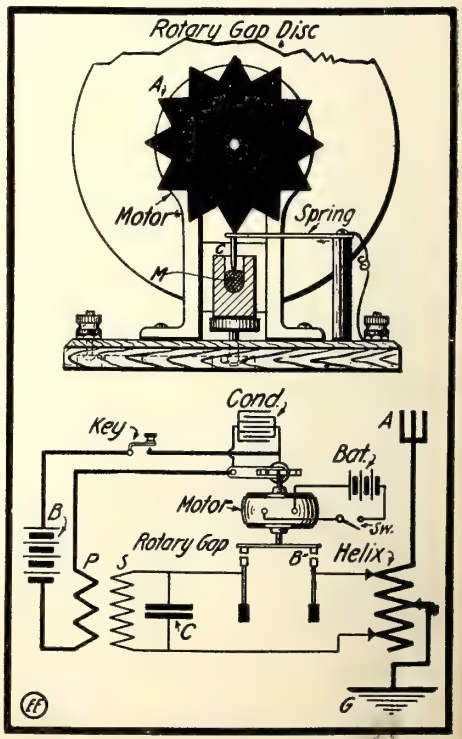
A new radio detector invented and patented by G. W. Pickard, sponsor of the present silicon, perikon and iron pyrite types, and known as the Perikon-Electra detector, is illustrated by the drawing here shown. This instrument consists principally of a very clever mineral stand which by means of properly designed adjustment screws permits the operator to quickly move the mineral cup B to whatever position desired under the contact point of steel or brass, P. Pressure on the point is varied by turning the thumb screw E. Details of the parts B and C are shown in the drawing, as well as the stiff spring and barrel A. The spring A is of the expanding type and when the mineral cup is mounted on the lever system, B—C, swinging on a fixed pivot X, secured to the base frame D, the spiral spring A tends to force the mineral cup B up diagonally against the two adjusting screws F and G. These screws are inclined at an angle of 10 degrees from the horizontal and exert pressure downward on the 10-degree tapered sides of the cup. Hence it becomes possible to simply adjust either screw, F or G, and thus move the mineral about under the contact point until the most sensitive spot is found.



A Detector for Radio Purposes, Capable of Quick and Accurate Adjustment.

MERCURY BREAK AND ROTARY FOR SPARK COILS.

The accompanying drawings represent a simple apparatus for obtaining a synchronized spark of a fairly high frequency from a battery-operated spark coil. B is an ordinary rotary spark gap with twelve zinc plugs. A is the contact breaker which takes the place of the vibrator on the spark coil. It is made of hard rubber or wood cut out with twelve points which, when rotating, make and break the current for the primary by making the brass point C come in contact with the mercury M contained in the carbon cup. A condenser should be put across the points of contact to reduce sparking. The cup is adjustable. The break disc should be set in such relation to the gap that the break occurs just as the plugs on the gap are approaching the stationary electrodes. The quicker the action of the spark coil the shorter must be the distance between the plugs when the break is made. With a little experimenting the right distance will be found. The apparatus is driven by a battery motor. With a motor speed of about 2,000 r. p. m. a spark frequency of about 400 per second will be obtained. Amateurs depending on batteries for transmitting will find that this machine will give a much higher pitched spark than with spring vibrator. The motor does not take much battery power to run.



Contributed by W. MORRISH.

Intensifying Radio Signals.

By Henri Sécore.

SEVERAL unique schemes for intensifying the weak signals received in radio-telegraph stations are mentioned in the French journal, T. S. F. (Télégraphie Sans Fil), and we describe the more interesting of these simple arrangements for intensifier experiments herewith.

The first method of constructing an intensifier is that illustrated at Fig. 1, where three carbon pieces C, C, C1 are mounted delicately on the diaphragms of two high resistance radio receivers T T. These receivers TT are joined in the place of the regular head 'phones of the wireless receiving circuit. The carbon piece C1 is pivoted between two indentations in the faces of the two upright carbon blocks C C, thus forming a microphone. When the diaphragms of the wireless 'phones T T move, due to incoming signal current acting on them, they also cause the resist-

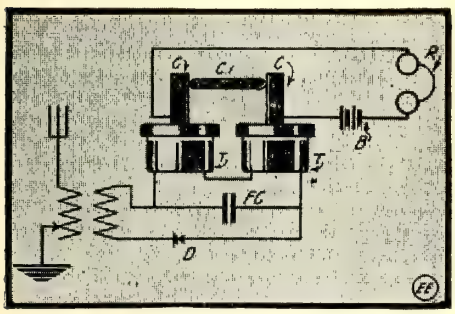


Fig. 1. Microphonic Form of Amplifier.

ance of the carbon block circuit or "microphone" to vary. This action causes a strong local battery B to act on a second pair of 'phones R, which can be 75-ohm type receivers, etc.

Another *stunt* is that outlined in Fig. 2, where a phonograph reproducer P with horn H is caused to give loud signals by virtue of the stylus or reproducer point resting on the diaphragm of a 75-ohm receiver T. This receiver is acted upon by varying current strengths from a battery B through a carbon grain microphone M. This microphone has its mouthpiece removed and is carefully placed in position against the diaphragm or cap of the high-resistance 'phone R, connected to the regular radio set. It may be remarked that the Editors have found these arrangements to work best when the diaphragm of the microphone M is glued or otherwise rigidly connected with the receiver R diaphragm.

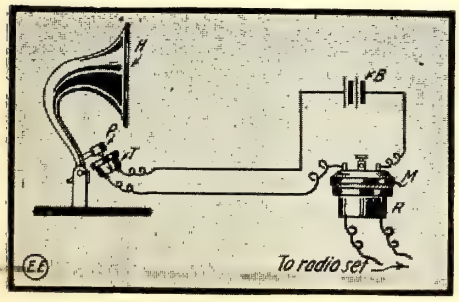


Fig. 2. 1,000 Ohm Receiver and Microphone Form This Amplifier Together with Phonograph.

A scheme similar to the last one was advocated by Stanley Hyde in *Modern Electrics*, but in a simpler form, i. e., the phonograph reproducer stylus was placed in contact with the diaphragm of the high-resistance wireless 'phone directly. Here, however, there is a chance to amplify the

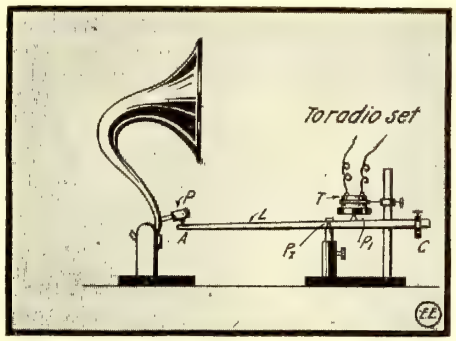


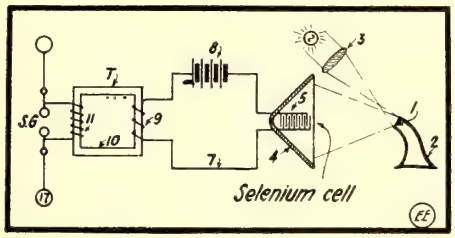
Fig. 3. Amplifying by Lever Action.

signals by controling the microphone "booster" circuit T M B. Those not having access to a phonograph reproducer may simply place a good size horn on the receiver opening of T, the diaphragm vibrations of it being heard then in the horn H.

The old principle of unbalanced lever action is employed in the arrangement indicated at Fig. 3. In this outfit, as shown, a delicately pivoted lever L is caused to act on the phonograph reproducer stylus P, at A, whenever the opposite end of the lever point P1 is acted upon by the movement of radio receiver (T) diaphragm. As is well known, if the lever is pivoted at P_2, or off center, then an increased motion radius is given at A, compared to the motion radius imparted at P_1, and which difference in movement amplitude is directly proportional to the ratio existing between the long and short arms of the lever L. A, C is a balance weight. The pivot P_2 is movable up or down on fulcrum rod with setscrew and sleeve as indicated.

SELENIUM CELL FOR WIRELESS TELEPHONE CONTROL.

A recent patent issued to a Brooklyn, N. Y., inventor possesses some very inter-



esting points which will, though perhaps not immediately practical, nevertheless become useful, undoubtedly, when the well known selenium cell is more perfected.

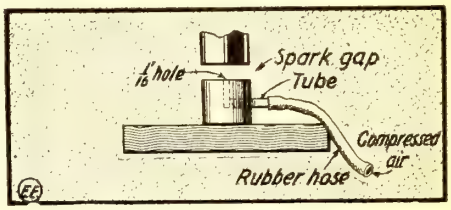
The diagram here given shows how this inventor intends to make use of the properties of the selenium cell (which lowers its resistance when a strong light is thrown on same, and vice versa) by placing the selenium cell 5 in the focus of a reflector 4. A mouthpiece 2, into which the voice waves are projected, has fitted on its inner end a small mirror 1. As the varying voice air waves impinge against the diaphragm and its mirror 1, it causes a corresponding varying beam of light to be projected onto the cell 5. This light is projected onto the mirror from some source of illumination placed behind lens 3. The selenium cell thus causes a changing resistance corresponding to the voice fluctuations at 2 to react through the transformer circuit 7, 8, 9, and thus sets up corresponding spark waves in the secondary of this transformer, as will of course be evident.

AN AIR BLAST SPARK GAP.

The spark gap has long been known as the most wasteful piece of apparatus in the sending set. The result is that experimenters have spent much time trying to overcome its disadvantages.

The object of special rotary gaps, etc., is to hold up the resistance of the gap, which falls very low, due to the heat of the passing spark, and also to the ionization of the air in the gap. By cooling the gap the former is done away with and an air blast will accomplish the latter by blowing the ionized air from the gap similar to a rotary type gap.

An air blast gap can be easily made from a plain zinc spark gap that will give good results. Remove the lower zinc plug and drill a 1/16-inch hole through its center. Drill another hole ⅛ inch diameter into



Compressed Air Spark Gap.

one side, so it will connect with the small hole. A brass or copper tube 1 inch long is forced into this hole to make a tight fit.

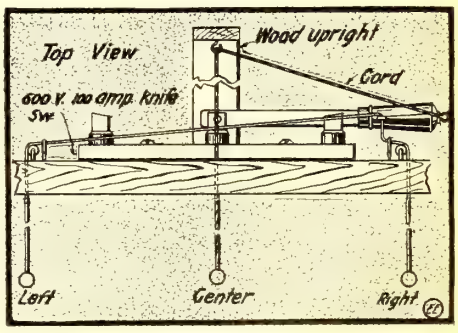
Replace the plug in the stand so the tube will project out at the back. The gap is connected in the circuit and a small rubber tube is slipped over the brass tube and long enough to reach the floor.

The air may be supplied by a bellows operated by the foot; or a better way would be to get a small tank and compress air into it and regulate its flow to the gap by means of a valve.

Contributed by
THOMAS W. BENSON.

INDOOR LIGHTNING SWITCH CONTROL.

Herewith is diagram of how I made a grounding switch attachment for my aerial, that is very convenient. It is very handy, and instead of going out in the yard on muddy and rainy days, by pulling the middle string the knife blade is brought into upright position. The other two strings (left and right) will ground or connect the aerial to the instruments. Small pulleys



Aerial Switch Controlled Indoors by Means of Three Ropes.

are best employed to pass the cord around bends and into the small holes cut through the window frame.

Contributed by JAMES R. ALLEN.

The D. C. Arc for Wireless Telegraphy and Telephony

(Concluded)

Majorana's Liquid Transmitter.

The illustration at Fig. 15 explains the principle of Majorana's transmitter. When water passes thru a small hole in the end of a tube, as shown at A in the diagram, it continues to flow in an unbroken column for some distance and then it breaks up into drops as shown at B.

Majorana's transmitter is shown on the right-hand side of the diagram. Tube A is in this case fitted with a small elastic

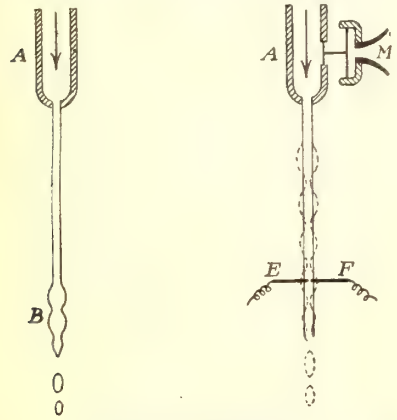


Fig. 15. Showing the Principle of the Water Stream Microphone.

partition near its end. This is attached to a rod leading from the diaphragm M. Two small rods or plates E and F are arranged near the bottom of the column just above the place where it forms into drops. These rods just enter the column a very little way and are connected to the circuit conveying the current which we wish to control by the voice.

Now, on speaking in front of M, vibrations are conveyed to the liquid by the rod from the diaphragm, and a sort of wave motion takes place down the column as shown in this diagram, its form depending on the voice, so that the electrical resistance of the column between the two rods is continually changing in exact accordance with the sound waves acting on the diaphragm.

The conductibility of the column can be varied within certain limits by the size of the hole in the tube and by the character of the liquid employed, whether it be acidulated water, salt water, mercury, etc., and also by adjusting the distance between the rods.

Vanni's Liquid Transmitter.

At Fig. 16 is depicted the transmitter which was used recently by Dr. Vanni in Rome in connection with a Morretti arc generator. Successful transmission of speech was accomplished between Rome and Tripoli, a distance of over 600 miles.

A small jet of acidulated water passes thru nozzle N on to a small plate F attached to diaphragm D; it splashes off this on to a fixed plate G; every movement of the diaphragm alters the resistance of the liquid between the two plates. The diaphragm may either be operated on directly by the voice, or it can be connected to a distant telephone circuit by means of the electro-magnetic device shown here.

Now a word or two as to the reception of signals when arc generators are employed for transmission.

When telegraphing, the arc generator is kept working all the time, and the signals are transmitted by shorting several turns of either the primary or secondary inductance by means of a Morse key, thus putting the transmitter either into or out of tune with the receiving station by altering its wave-length.

Fig. 17 shows Poulsen's connections for reception. As no interrupter is employed at the transmitting station to break up the wave train into groups of waves whose frequency is sufficiently low as to be audible in a 'phone, no signals can be heard with ordinary receiving connections. A small vibrating contact-breaker is, therefore, employed at the receiving station, known as a tikker. When using this instrument no detector is required. Its action is as follows:

The receiving circuit is intermittently connected by a tikker to a large condenser O (about 1 microfarad capacity). During the time of contact the condenser becomes charged, and when the contact is broken it discharges thru the telephone, producing a note corresponding to the frequency of the tikker interruptions. Mr. Child, of the London Telegraph Training College, has very kindly lent me a tikker which I shall be very pleased to show to anyone interested at the close of the lecture.

For the reception of speech, the detectors and connections used are similar to those for spark signals, the most sensitive detectors being those of the crystal type, such as Pickard's original silicon detector, or a zincite and copper pyrites detector. Electrolytic detectors are particularly reliable for telephony, and Fleming's oscillation valve also acts very well.

Fessenden has invented a very clever telephone receiver, which he terms the "Heterodyne." It consists of two small coils, one wound on a fixed core of fine iron wires, and the other attached to a mica diaphragm having its plane parallel to the first. The first coil is connected to a local source of "high frequency" current tuned to agree as exactly as possible with that of the transmitting station; the received oscillations pass round the diaphragm coil. The mechanical

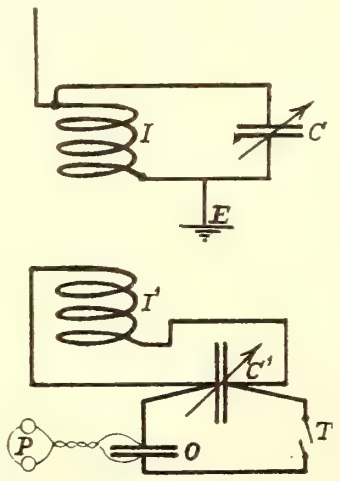


Fig. 17. Poulsen "Tikker" Receiving Connections.

force between the two coils varies in accordance with the voice at the transmitting station and reproduces the words spoken.

I have been experimenting myself for some time past with a hot wire telephone on the principle of that invented by Pierce for line telephony in 1880. I find that this telephone can also be connected direct to the oscillating receiving circuit without the use of a detector; but, as you see, the apparatus is very crude and is no doubt capable of much improvement. As this is a lecture on arc systems, I have made very little mention of H. F. alternators.

There is, however, very little doubt that in the near future the Goldschmidt H. F. alternator will be used for wireless telephony, and Professor Fleming thinks that by its employment even Transatlantic wireless telephony may be possible. The time is probably coming when we shall be able to converse with our friends at sea from our own houses, using telephones similar to those so many of us already have installed. We shall ring up the Telephone Exchange

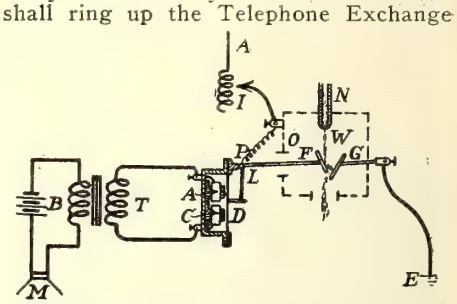


Fig. 16.—Dr. Vanni's Liquid Transmitter. A Variation in the Liquid Stream N is Caused by the Magnet Coils A-C and diafram D.

and ask to be connected to some large wireless telephone station on the coast, and the operator there, having got into communication with the ship to which we desire to speak, will connect up our simple telephone circuit to his elaborate wireless instruments, to which he will attend while we converse.

The paper was followed by an interesting debate.

Dr. Erskine Murray, after thanking the lecturer, said that rather debatable ground had been touched on by the lecturer in reference to the Lepel system. It was by no means certain that both the primary and secondary oscillations took place through the spark gap. With reference to the Poulsen system, he said that he had himself, several years ago, seen a Poulsen arc working continuously, without adjustment, for over a quarter of an hour, and it was a great wonder that wireless telephony was not made more use of commercially.

Mr. Binyon said that reference had been made to the Goldschmidt alternator. He was himself employed by the Goldschmidt Co. and was glad that the lecturer was so optimistic as to its future; but he thought that Transatlantic wireless telephony, altho in all probability on the verge of accomplishment, would never become of great commercial value. Transatlantic telegraphy is carried on at high speed in order to cope with the enormous number of messages transmitted. Too much time would be taken up by telephony, and people would not care to carry on important conversations to which any amateur station could listen.

Mr. Maurice Child made some very humorous remarks as to the result of wireless telephony in the Channel. He suggested that some very bad language might be heard if all sea captains were to try and speak to each other at once by wireless telephony.

Mr. Leslie Miller stated that he had seen aluminum used in place of carbon for hydrogen arcs with very good results.

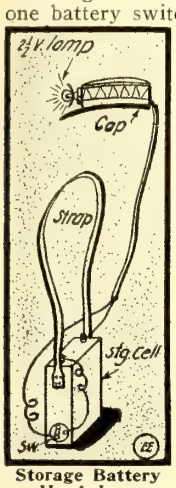
HOW-TO-MAKE-IT DEPARTMENT

This department will award the following monthly prices: FIRST PRIZE $3.00; SECOND PRIZE $2.00; THIRD PRIZE, $1.00.
The idea of this department is to accomplish new things with old apparatus or old material, and for the most useful, practical and original idea submitted to the Editors of this department, a monthly series of prizes will be awarded. For the best ideas submitted a prize of $3.00 will be given; for the second best idea a $2.00 prize, and for the third best a prize of $1.00. The article need not be very elaborate, and rough sketches are sufficient. We will make the mechanical drawings.

FIRST PRIZE $3.00

A STORAGE BATTERY HANDY LAMP.

Campers, cyclists and Boy Scouts will find this lamp extremely handy and practical. The articles that are used in constructing this lamp are: One storage cell, one battery switch, one 2½-volt lamp, one miniature socket, 10 feet of annunciator wire or lamp cord.



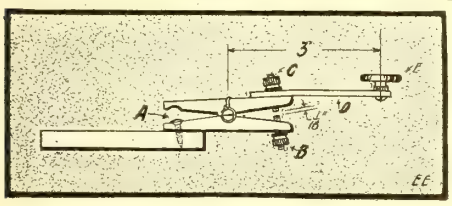
Storage Battery Head Lamp.

The remaining smaller articles can be found around the house. After your storage cell has been charged set it in the pasteboard box that it originally was received in, or better, make a metal carrier for it. Then fasten a leather strap on both sides of the box so it will fit comfortably on your back. Take another piece of leather and make a head band to put around your hat or cap and rivet the miniature socket to it, as shown. On the bottom of the wooden battery switch drive a small nail and bend so as to make a hook to fasten the switch to your coat or any other part of your clothing. Make or buy a little reflector of polished tin or nickel to fasten on the socket. Connect as illustrated and your lamp will be ready for use.

HAROLD B. FINKELSTEIN.

A CHEAP TELEGRAPH KEY.

A very simple key for experimental wireless work can be made very easily. Procure a piece of wood 3x3 inches and give this a good coat of shellac. Next, get a spring clothes pin and fasten this at A, leaving 1½ inches of the pin projecting



Telegraph Key from Clothes Pin.

from the board. Bore a hole in the upper and lower pieces about ½ inch from the ends. Procure two binding posts off some old batteries, and fasten these in the holes, having them about ⅛ of an inch distant, with clip in normal position. The wires can then be attached at B and C, as shown in the diagram. Place a strip of brass D, under the nut C, with a telegraph knob, E, at the outer end, or the knob may be placed on screw C.

Banana oil or turpentine is excellent for pasting tinfoil on transmitting condensers.

NOTICE!!!

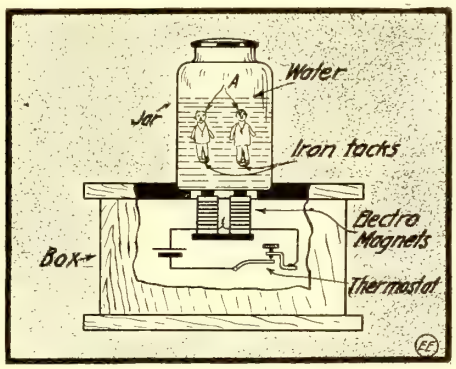
We wish to buy May, '13, Oct., '13, and Jan., '14, copies "E. E." Address the Editor.

SECOND PRIZE $2.00.

A NOVEL ELECTRICAL WINDOW ATTRACTION.

A novel attraction for a window display can be made from a fruit jar filled half way with water and supported over two electro-magnets, which are mounted in a box or covered over with some cloth as shown in illustration. Two or three small figures A are made from cork and painted with some white paint. Now insert on bottom of each figure A an iron tack or a small iron nail.

When everything is ready connect the electro-magnets in series with a thermostat and place the figures in the water. As soon as the current is made the figures will dive to the bottom of the jar, and when the magnet is opened the figures will rise again



Electrical Window Attraction.

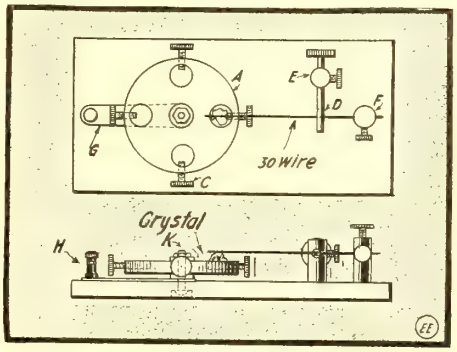
to the surface. The operation is continuous as long as the thermostat makes and breaks the circuit. Thermostats are readily purchased in any electrical store.

CONTRIBUTED BY L. WEISS.

A ROTARY "CAT WHISKER" DETECTOR.

For all around service the universal or cat whisker detector gives good results. The cat whisker detector herewith described is easily made.

The cup A is made of brass ⅜ inch thick and 2½ inches in diameter. The



Rotary Mineral Holder.

holes are ⅝ inches in diameter. The brass screw K holds A to the base, so that it can turn. G is a brass strap 1/16 inch thick and ⅜ inch wide which connects A to the binding post H. This strap is not necessary as the connections can be made with wire under the base. Electrical connections are made with H and F.

All the parts should be nickel-plated and polished.

THIRD PRIZE $1.00.

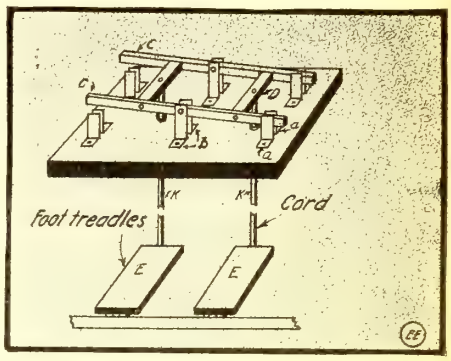
A FOOT-CONTROL AERIAL SWITCH.

This switch is designed to give rapid switching of the aerial circuit connections to the foot control of the operator. When he is using his instruments he sometimes finds it rather difficult, after sending, to throw the switch and make all the necessary adjustments before the return call commences to come in. This device, by eliminating one movement at least of the hands, saves time.

The sketch illustrates all the parts required. If desired the eight parts A may be substituted by four parts made in one piece; the same also applies to B. The instrument may be mounted directly on a table or may have a base, and may then be placed on the table, through which the holes for the treadle cords have been previously bored.

Too much pressure should not be applied to the treadles, as undue strain might injure the switch.

The blades CC can be of copper or brass bar about ⅛ to ⅛ inch thick by ½ inch wide and 8 to 10 inches long. The



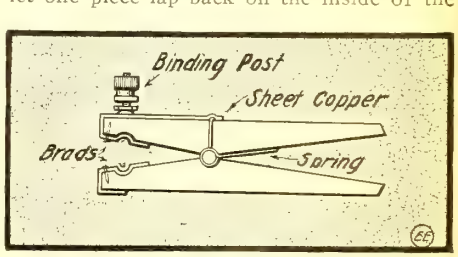
Foot-Operated Aerial Switch.

base is best made of waxed wood or marble. The jaw contacts AA, etc., should have their upper ends slightly flared out so the blades will enter them without binding. The cross bars DD are of fiber or hard rubber. Contributed by

A. D. R. FRASER.

A HELIX CLIP.

An efficient helix clip may be made from an ordinary spring clothespin. Fasten a thin piece of sheet copper on the inside of each jaw of the pin, using small brads, and let one piece lap back on the inside of the



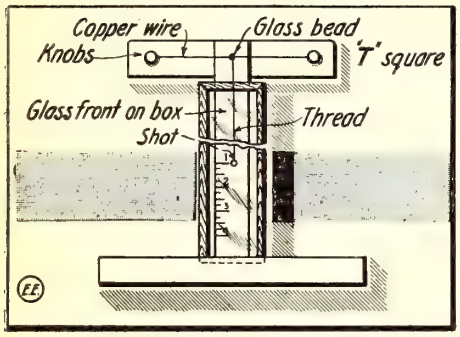
Helix Clip of Simple Construction.

pin for about half an inch. Solder a flat head 8-32 machine screw on the overlap and screw a nut from a dead dry cell on this to form a binding post,

"SIMPLEST" HOT WIRE AMMETER

The diagram shows how to make a simple but accurate device for finding the best radiation of a radio transformer of a half kilowatt or over. The device is simple and can be made by most every wireless experimenter.

Two small knobs are attached to the head of the T-square and a No. 36 copper wire stretched between them. From the



Very Simple Hot Wire Ammeter.

center of this wire is suspended a small lead shot on a silk thread, with a glass bead.

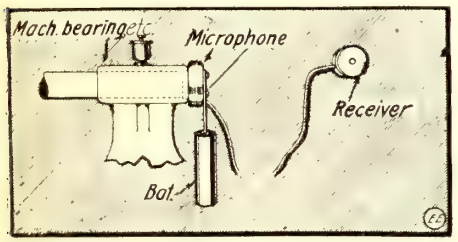
When put in series with the ground, the wire expands, causing the shot to drop slightly; and, after adjusting the helix clips till the shot is lowest, the greatest radiation is obtained.

For some transformers the wire may have to be larger or smaller than 36, depending on the transformer used.

Contributed by
RANDOLPH ROLAND.

DICTAGRAPHS FOR TESTING MACHINERY.

The ultra-senitive telephone set, commonly known as the Dictagraph or Detectiphone, is applicable to many different problems encountered in every-day work. A very useful application of this instrument to the requirements of machine erectors, etc., is illustrated in the sketch. Here the extremely sensitive microphone transmitter of the dictagraph is placed in contact with the metallic frame of the machine or, in the case of a shaft bearing, at the end of the journal housing, as seen in the cut.



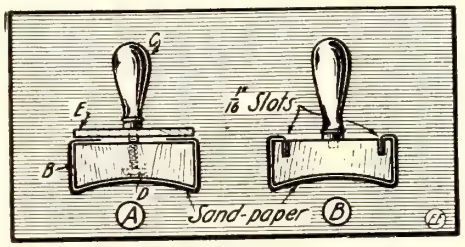
Dictagraph Helps Machinists to Hear Knocks in Machinery.

By listening in the telephone receiver of this set the slightest knocks or other undue noises in the machine, which would not, perhaps, be perceptible to the ordinary ear unaided, will be heard plainly in this instrument. This form of telephone is simply a series instrument, and the battery, microphone and receiver are all joined in series. It is therefore easily possible to rewire same and place the battery at any point in the circuit desired, or the circuit may be made as long as 50 to 75 feet. No. 16 lamp cord can be used for the circuit under such conditions.

Always connect the lead-in wire from your highest point and avoid leaving kinks and unnecessary turns in it.

SAND-PAPERING COMMUTATORS.

One of the commonest jobs the electrician around motors in industrial plants has to bother with is keeping the commutator in good shape. All commutators at some time or other tend to burn and blacken a little bit, and a common remedy to smooth them while they are running is to apply a piece of sandpaper. We show herewith a couple of commutator blocks made out of hardwood suitable for holding a piece of sandpaper nicely without fear of shock to the electrician or motor attendant. In the model shown at A a back piece of wood E is caused to clamp the sandpaper tightly when the handle C is tightened up by means of its threaded stud and nut secured in a recess in the center of the block, this nut being, of course, square or hexagonal in form so as not to turn. The second form of sandpapering block at B in sketch is very simple to make, and has two 1/16-inch slots cut in the two sides of same at the back. The sandpaper is then simply fastened in each slot, and may be held by a thin piece of wood if desired. In either case it should be noted that for best results, and as followed out in one of the largest industrial plants of the country, it is al-



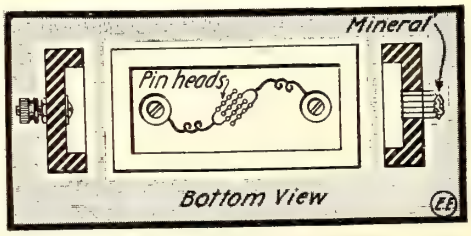
Sand-Paper Blocks for Dressing Commutators.

ways best to have several of these blocks with different radii curves on their faces to cover the range of several sizes of commutators which may be around the plant. It is not advisable to use a flat block face.

A useful hint in this direction lies in the use of a common scythe-sharpening stone, which is quite soft and nonconducting. When a commutator is badly cut and temporary improvement is necessary in the operation of the motor such a stone is pressed on to the commutator, and it is thus dressed down while running. Always use sandpaper for commutator work and never emory paper.

PIN-POINT MINERAL TESTER.

The pin-point detector and mineral tester is constructed with two battery screws, two battery thumb nuts, two washers, 16 common brass pins, one block of soft wood 3 inches long by 1½ inches wide by ¾-inch thick. Hollow out the block, as is shown in drawing, leaving the sides, ends and tops one-quarter of an inch thick. In the middle of the block drive your pins in rows, being careful that the



A Pin-Point Mineral Tester.

pins do not touch each other and allowing the points to project through the top about one-sixteenth of an inch. Connect the pin-heads as shown in drawing, soldering the lead wires to the pin-heads and binding screws. Place a piece of mineral on the pin points as in drawing No. 1. To adjust the detector rap it lightly so as to jar the mineral.

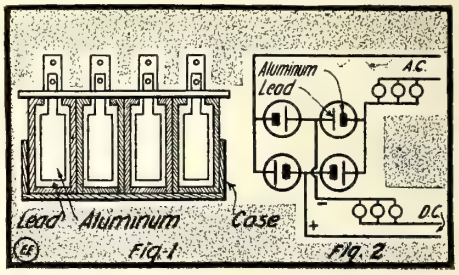
This detector will be found very handy for testing mineral, as there is no adjustment screws to handle. I find this detector much more sensitive than anything I have ever tried.

Contributed by C. P. STONE.

HOW TO MAKE AN ELECTROLYTIC RECTIFIER.

A very simple device which will change an alternating current to a direct current can be constructed for less than a dollar.

First obtain four jars (see Fig. 1) and place them in a suitable box. Next obtain a board just large enough to go across the four jars. Mark a circle on the board under each jar. Mount then an aluminum



Four Cell Electrolytic Rectifier.

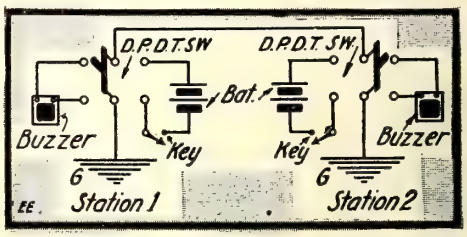
and a lead plate ½-inch apart under each circle, as shown. The lead plates should be a little larger than the aluminum plate; a suitable size is 4x6x⅛ inches. Both plates can be fastened to the cover by bending over a ⅜-inch ear at the top and using some wood screws.

Fill the jars to within 1 inch of the top with an electrolyte made by dissolving as much sodium phosphate as possible in the water and adding a few drops of sulphuric acid for low voltage rectification, such as 12-20 volts, etc.; connect the cells as shown in Fig. 2. This rectifier may be used on an alternating current circuit up to 220 volts. On 110 volts it will give 3 to 3½ amperes D. C. at 80 volts, and on lower voltages it will operate with reasonable efficiency. It will take about half an hour for the plates to form after the alternating current is turned on. Both halves of the cycle are rectified with this rectifier.

A BUZZER TELEGRAPH SYSTEM.

The sketch, I think, will be interesting to your readers.

The diagram shown is for an open circuit telegraph set that most anybody can easily put up. It requires the following apparatus: Two D. P. D. T. switches, two



Simple Buzzer Telegraph System.

buzzers, two keys and batteries. To operate the set the switch handle is always left on the receiving or buzzer side. When the operator wishes to send he throws it on the right and calls the other party.

I have used this set for some time and get fine results.

Contributed by FRANK HARAZIM.

AN UNUSUAL COUPLER.

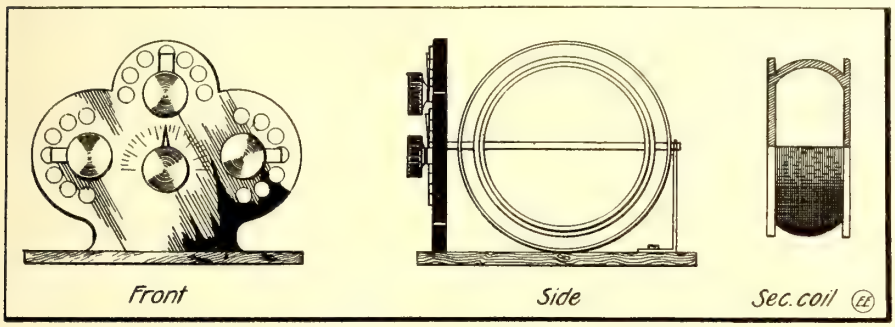
It is a well-known fact that the efficiency of most receiving sets is very low. This loss is due to the inefficient method of transforming the oscillations from the antenna to the closed or detector circuit. This loss is especially great when two couplers are connected in cascade for elimination of interference. The coupler here described, although not new, is seldom, if ever, seen in the amateur station.

We know that when undulations energize the aerial it sets up a weak magnetic field about the primary. Now, in order to energize the detector circuit to a maximum it is up to us to construct a secondary suitable to absorb the most lines of force. So we make a form like the one in illustration, which has many advantages over the common cylindrical form. This can easily be turned on a lathe.

Start winding your coil from both ends and then solder them together at top, taking taps about every twenty-fifth turn to vary inductance. Any number of layers can be used.

The primary coil is of the common variometer type. Start winding at either end, taking taps first 10 and then every other 10. This eliminates the losses otherwise due to sliders. Sizes 24 and 30 B. & S. wire are suitable for primary and secondary, respectively. The illustration elucidates the minor details. A coupler built similar to this is very efficient and gives a handsome appearance, as sought by every up-to-date experimenter.

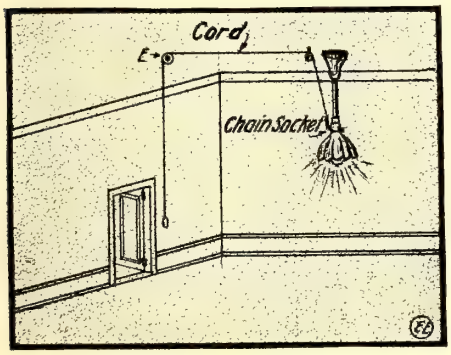
Contributed by ROBT. C. MARTIN.



Particularly Efficient Form of Loose Coupler with Spherical Secondary.

CONTROLLING LIGHT FROM THE DOOR.

Quite frequently rooms are lighted by pendant fixtures which are turned on and off by a pull-chain socket at the fixture.



Controlling Electric Lamp by String.

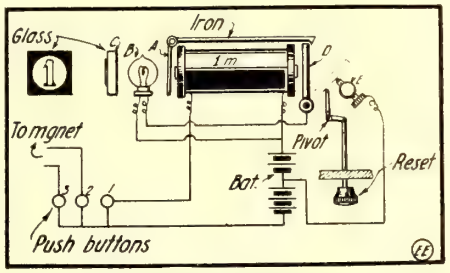
This makes it necessary to grope through the dark room in order to find the chain. This annoyance may be obviated by the use of a piece of cord and two screw eyes E, as shown in the drawing. Screw pulleys would be better but are not necessary, as the cord will pass easily through the eyes. A small porcelain insulator hung on the end of the cord will serve as a hand grip and will also tend to keep the cord taut. By using a cord of the same color as the paper over which it passes a very neat job may be made indeed. A rubber band may be placed in the cord line so as to prevent severe jerking of the socket mechanism. Contributed by

HAMILTON A. HOOPER.

FLASH-LAMP ANNUNCIATOR.

A different form of indicator or annunciator than the one we are all more or less familiar with is the subject of these few lines. In many cases it is very desirable to have an annunciator operating on the same principle as the telephone switchboard, i. e., where the signals are flashed by means of small lamps placed behind glass bull's-eyes with numbers painted on them.

The arrangement shown in the sketch herewith indicates a very simple arrangement, easily constructed by the amateur electrician and at small expense. Also the principle can very well be carried on to include quite a number of indicators, as will be evident. Briefly, the principle of this flash light indicator is as follows:



Flash-Lamp Annunciator.

An electro-magnet 1M has fitted onto it a soft iron armature A, pivoted as shown; so that when an electric current passes through the magnet coil it will attract the shorter end of A, and thus release the brass switch drop D. This drop then falls onto the contact screw E, thus closing the flash-lamp circuit through the battery. Primarily the signals are sent into the indicator to the respective magnet coils 1M, etc., from the push puttons 1, 2, 3, etc., placed in various parts of the building. The glass disc C can be made of ordinary glass and the front of same painted with some lampblack as shown. After each signal has been answered by the attendant the drop D is readily reset by the small button as shown in sketch.

HINT FOR CONDENSER MAKING.

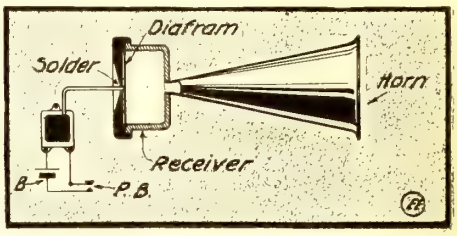
Use a warm, flat iron, instead of the old-time hot knife and roller, to make your condensers and you will be surprised at the ease with which it can be accomplished. The condenser will be much more compact than it could possibly be made by rolling, thus increasing the capacity likewise.

Contributed by

ARTHUR R. DARLING.

HOW TO MAKE AN ELECTRIC HORN.

The following material will be needed in building this horn: An old watch case receiver, an electric bell and a wood base of any size; also a block for the bell to rest on. Now remove the magnets from the receiver and drill a 5/8-inch hole through the back of the shell. Next procure a tin horn at a toy store for about 10 cents and remove the whistle on the inside. Next cement the horn to the holder in the back of receiver, or solder it in place if the shell is of metal. That having been done, replace the diafram and screw the cap on. Next cut the ball off the tapper of the bell, remove the gong and bend the rod at right angles as shown in figure. Then solder the end of the arm to the diafram. This horn will give a loud sound, especially if used on five to six dry cells B. A push button is placed at PB.



Easily Made Electric Horn.

SPARK PICTURES.

The photos of sparks herewith reproduced were taken with a one-inch spark coil, but the batteries were run down and the sparks would only jump a half inch. However, the picture turned out quite satisfactorily. For the benefit of the reader I will describe the experiment. The material used consists of a photographic plate, metal plate, talcum powder, two pieces of wire and a needle. (The photographic plate should not be exposed to any light.)

First of all fasten one wire leading from either of the secondary posts of the spark coil to the metal plate. Place the photographic plate on the metal plate, with the gelatine side up, and sift the talcum powder through a piece of cheesecloth evenly over its surface. To the other secondary post of the coil fasten the other wire. Attach the needle to the other end and hold it on the middle of the plate. Make one spark, brush off the powder and the plate is ready for developing. Startling results can be obtained if the above is carried out correctly.



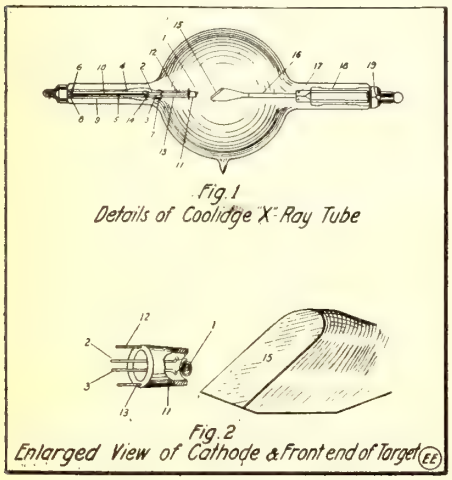
Contributed by WM. A. STEPHEN.

THE NEW COOLIDGE X-RAY TUBE

The new Coolidge X-ray tube is a direct outcome of Dr. W. D. Coolidge's previous invention of ductile tungsten, the physical properties of which enable its substitution for platinum as the target or anti-cathode in X-ray tubes.

The Coolidge tube is shown in detail in Fig. 1, while Fig. 2 gives details of the cathode and front end of the target.

The construction of the cathode can be seen from Figs. 1 and 2, in which (1) is a tungsten filament forming a flat, closely wound spiral. This tungsten filament (which consists of a number of convolutions) is electrically welded to heavy molybdenum wires (2 and 3), to the other extremity of which are welded the two copper wires (4 and 5), these being in turn welded to the platinum wire (6). To insure rigid support for the hot filament the molybdenum wires are sealed directly into a piece of special glass (7) which has the same coefficient of expansion as molybdenum. The outer end (8) of the supporting tube is of soda glass like the bulb itself, and it is therefore necessary to interpose at (9) a graduated series of different kinds of glass to allow for the difference of expansion of (7 and 8). A small glass tube (10) surrounding one of the copper leads prevents short-circuiting of the copper wires (4 and 5). The tungsten filament which forms the cathode is heated by a current from a small storage battery, which should be carefully insulated from the ground. An ammeter and an adjustable rheostat in the circuit enable the heating current to be regulated with great nicety between 3 to 5 amperes. This range of current gives a potential drop through the filament of from 1.8 to 4.6 volts, variations of the corresponding filament temperature being from 1,890 to 2,340 degrees absolute.



The Famous "Coolidge" X-Ray Tube.

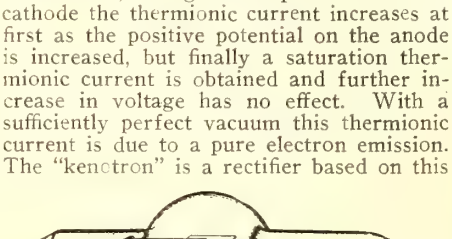
The focusing device consists of a cylindrical sleeve of molybdenum (11). It is mounted so as to be concentric with the tungsten filament, with its end projecting about 0.5 mm. beyond the plane of the latter. It is supported by two stout molybdenum wires (12 and 13) which are sealed into the end of the glass tube (7) (see Fig. 1). The sleeve is electrically connected to one of the filament leads (14). This, besides acting as a focusing device, also prevents any electron discharge from the back of the heated portion of the cathode. The anti-cathode or target (15), Figs. 1 and 2, also serves as an anode. It consists of a single piece of wrought tungsten welded to a molybdenum rod (16) of cylindrical section and supported by a molybdenum split tube (17). This split tube fits snugly in the glass anode arm (18) and serves the double purpose of supporting the anode and of conducting heat away from the cylindrical rod and so protect the seal of the inlet lead (19). The bulb is made of soda glass and is about 18 centimeters in diameter. The method of exhaustion is very long and complicated, and in the later stages of the exhaustion a very heavy current is maintained continuously on the tube for perhaps an hour, the temperature of the bulb being kept from rising too high by the use of a fan. The pressure in the finished tube is very low.

The main advantages of the Coolidge tube are the following: The quantity and the pentrating ability of the rays produced can be varied independently at the will of the operator with both ease and rapidity. When the tube is once adjusted to the requirements of the operator it needs no further attention. Both the intensity and the penetration of the X-rays are under the complete control of the operator. A higher penetration than can be obtained from any other tube is claimed, as well as a longer life. The tube can be worked off either alternating or direct current. Hence it is possible for an operator in actual practise to do all classes of work, ranging from that calling for the lowest to that calling for the highest penetration, with a single tube. Further, he can reproduce exactly what he or some other operator has done before. The adjustments are rapid and require the minimum of technical skill. It has been found that once the proper penetration and exposure had been determined radiographs of any object can be duplicated time after time with absolute precision.—*The Electrician*, London.

THE "KENOTRON" HIGH POTENTIAL RECTIFIER.

A new form of vacuum rectifier is described in a recent number of the *General Electric Review*.

When the electrically heated electrode in the bulb shown is cathode only a thermionic current passes. For a given voltage drop this thermionic current increases with the temperature, but above a certain temperature the current becomes constant. On the other hand, for a given temperature of the cathode the thermionic current increases at first as the positive potential on the anode is increased, but finally a saturation thermionic current is obtained and further increase in voltage has no effect. With a sufficiently perfect vacuum this thermionic current is due to a pure electron emission. The "kenotron" is a rectifier based on this



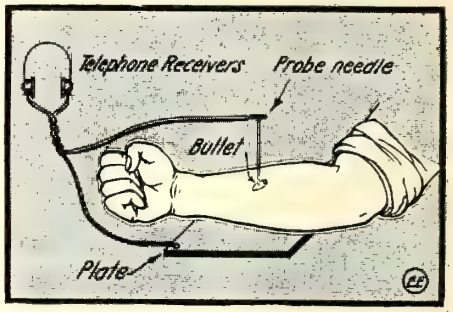
New Form of Vacuum Rectifier Tube.

phenomenon, and the article discusses how the design depends on the amount of current to be rectified, the maximum permissible voltage loss and the proper form of electrodes to prevent electrostatic strains on the filament. Three different forms of kenotrons are covered. The first type contains a molybdenum cylinder and a coaxial filament and is suitable for alternating-current voltages up to 15,000 and a current of 400 milliamperes and voltages up to 100,000 and a current of 100 milliamperes. The efficiency of this rectifier is between 98 and 98.75 per cent. A second type of "kenotron," which is suitable for voltages not over 10,000 and currents ranging up to 100 milliamperes, contains a small filament such as is used in automobile head lamps inserted in a molybdenum cap about ⅝ inch in diameter. A third style is shown in our illustration. It contains a V-shaped filament between two tungsten plates.

Hence this new form of rectifier promises to fill a number of engineering wants.

ELECTRICAL BULLET PROBING.

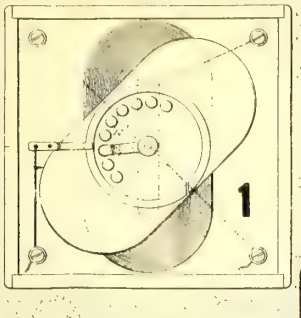
A new electrical method of probing for bullets is being employed in the military hospitals of Europe, says the *Lancet*, London. It consists of a head telephone receiver such as a sensitive wireless phone, together with a flat metal plate and a probing needle of the same metal. The patient's arm, for instance, is placed on the metal plate, which is connected to the telephone receiver, as is also the probing needle. When the surgeon touches the bullet with the needle there is formed a galvanic battery. This gives rise to an electric current which is heard in the receiver. Sir James MacKenzie Davidson says this method is undoubtedly more certain and easier to apply than the "induction balance," also in use for the purpose.

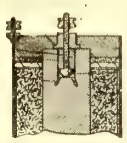


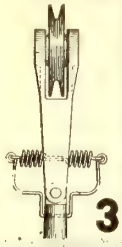
Locating Bullets with Telephone Receivers Only.

TESTS OF PERMANENT MAGNET STEELS.

J. A. Mathews has contributed to the proceedigs of the American Society for Testing Materials a paper based upon an extensive series of magnetic tests on steel alloys. The amount of permanent magnetism which hard steel will retain, and the tenacity with which it retains it, are profoundly affected by the heat treatment of the steel, as well as by its chemical composition. But different steels are affected differently by heat treatment. Some have their best permanent-magnet quality in the oil-hardened condition, while others —sixty hundredths per cent. carbon steel and five per cent. tungsten steel—are best when water-hardened. Thus, the "magnetic hardness" does not vary in the same way as physical hardness. Drawing the temper, however, reduces both hardness and magnetic permanence. In some steels, pieces of small section have greater permanence than larger pieces, while other steels have the opposite characteristic. The chief result of the tests made up to the present is that no uniformity of behavior is found among different steels, and that no laws or theories covering the phenomena can be deduced before a great amount of further experimenting has been done. The author found the best index of permanent-magnet quality to be the ratio between residual magnetism and coercive force. He proposes this ratio as a new magnetic unit.


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A Brief Digest of the Latest Electrical Patents

WIRELESS TRANSFORMER (Fig. 1)—Compact loose coupler with pancake coils independently movable co-axially.

BATTERY CONNECTION (Fig. 2)—Improved dowel terminal for carbon electrode in dry cells.

TROLLEY WHEEL MOUNTING (Fig. 3)—Wheel is mounted with lateral thrust springs to give wider range of action, so it will not release its hold on trolley wire so quickly.

LAMP CONTAINER OR BOX (Fig. 4)—A simple carton to hold electric lamps while in shipment, etc.

HEAD-BAND ATTACHMENT (Fig. 5)—An extra flat plate secured to the head-band prevents band catching hair. A good idea and a boon to the telephone exchange operator.

ELECTRIC SIGN (Fig. 6)—Has bull's-eye lenses over each lamp, etc. Gives spectacular effect as liquid filling glass, etc.

MUSICAL DEVICE (Fig. 7)—Electrically operated striker for musical pipe, as shown.

PORTABLE ELECTRIC LAMP (Fig. 8)—Arranged with base attachable to anything. Socket also swivels.

ELECTRIC SOCKET (Fig. 9)—Arranged with a pull chain and lever, acting on push button switch.

STORAGE BATTERY SEPARATOR (Fig. 10)—Ingenious insulating envelope to fit over battery plates and to separate them from one another.

WIRELESS RECEIVER (Fig.) 11)—Magnet spool movable to or away from diaphragm by threaded thumb lever at rear, as shown.

TELEGRAPH RECORDER (Fig. 12)—Devised to operate on the sounder principle, the armature bar carrying a stylus, as indicated.

ELECTRIC HEATER (Fig. 13)—In the form of a cup to contain liquid and a food cup with perforated walls, held on heating element at center.

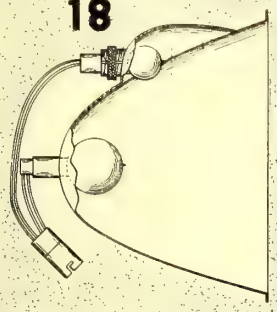
AUTO HEAD-LAMP AND SIGNAL COMBINED (Fig. 14)—Horn vibrator is mounted in rear of headlamp. Openings provided for efflux of sound. Tends to reduce the cost of auto manufacture, as both functions are combined in one chamber.

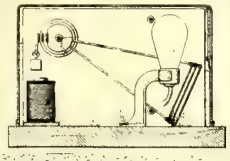
BEDSTEAD ELECTRIC LAMP (Fig. 15)—Provided with hooks to hang on bed rail. For reading.

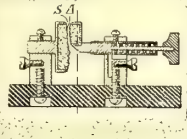
NEW PICKARD RADIO DETECTOR (Fig. 16)—Uses silicon "S" and antimony "A."

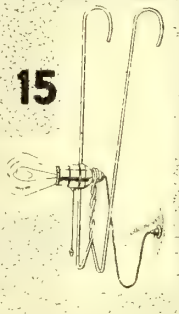
CORNER-TURNING INDICATOR FOR AUTOS (Fig. 17)—Electro-magnet control operates sign frame arms, as perceived; signs appear before window with lamp behind them.

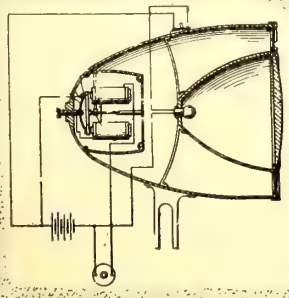
DUPLEX AUTO HEAD-LAMP (Fig. 18)—Good idea for providing small, city lamp in pocket at side of parabolic reflector, containing the regular head-lamp.


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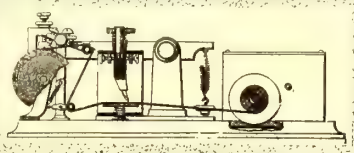

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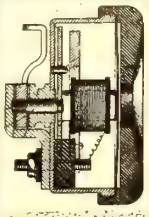

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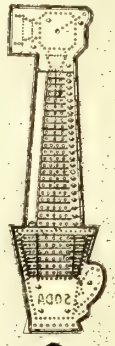

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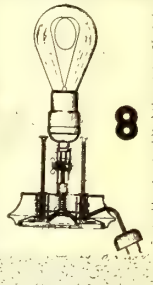

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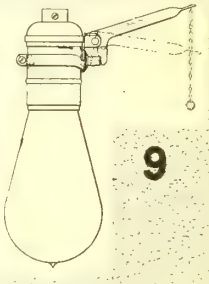

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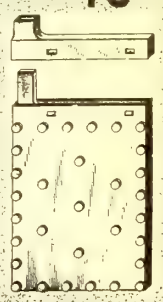

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AMONG THE AMATEURS

Our Amateur Radio Station Contest is open to all readers, whether subscribers or not. The photos are judged for best arrangement and efficiency of the apparatus. To increase the interest of this department we make it a rule not to publish photos of stations unaccompanied by that of the owner. Dark photos preferred to light toned ones. We pay each month $3.00 prize for the best photo. Make your description brief. Address the Editor.

AMATEUR RADIO STATION CONTEST.

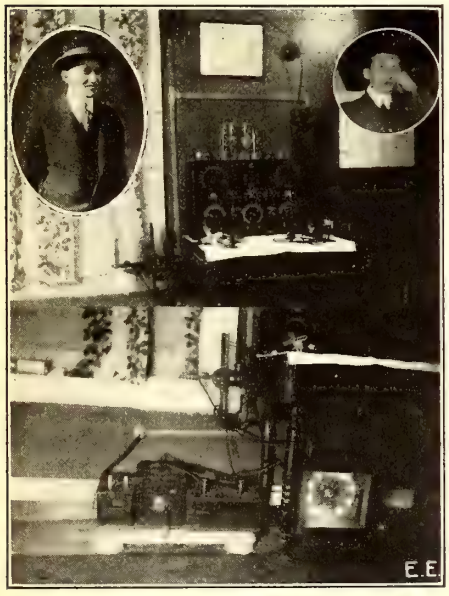
Monthly Prize, $3.00.

This month's prize winner.

WAYNE BROS. AMATEUR RADIO STATION.

Herewith are submitted photos of a wireless set, which may interest some of your readers. Before proceeding, allow me to say that this set is of entirely amateur construction, having been built by my brother and myself.

The photos show clearly the outer appearance of the set, but a brief description of the interior follows. I might first say that the receiving cabinet is entirely of hard rubber, and measures over all 20x12x10 inches. Contained within are a receiving transformer, loading inductance, and variable condensers. There are also the two sets of high-voltage batteries for the audions, and also the 1 to 1 ratio transformer for the amplifier. All coils are wound with stranded wire (or litzendraht) which much improves their efficiency, of course, for high frequency. The hook up of the set, which, so far as I know, is original with us, enables us to receive both damped and undamped waves with equal facility, and we have clearly



Messrs. Wayne Brothers and Their High-Grade Radio Set. Top: Receiving. Below: Transmitting.

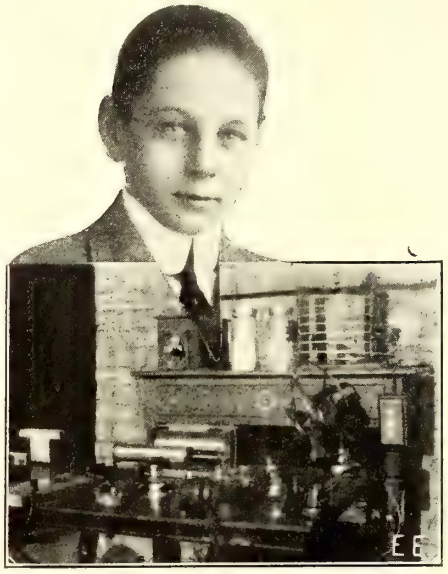
heard on several occasions the high-powered stations at Berlin, Honolulu and San Francisco, which employ the undamped wave system for transmitting.

On ordinary spark sets, we have heard signals from Key West, Colon, and numerous ship sets, covering 1,100 miles in daytime; signals being from ships using the average transmitter employed on shipboard. We have also copied "press" from Poldhu, and have heard time signals from Arlington at a distance of 40 feet from the phones.

The transmitter is all home-made, and of one-half K.W. power. Transformer is

WEITH WIRELESS OUTFIT.

The following is a description of my wireless station, located at Chicago, Ill.: My receiving set comprises a double slide



Master Weith and His Radio Station.

tuner, variable condenser, fixed condenser, loading coil, battery, potentiometer, galena and also a silicon detector, 1,000-ohm phones and a high note buzzer for testing the detectors. The receiving set is on the bottom part of the table; all necessary switches are used.

My sending outfit is composed of a ½-kw. transformer which runs on the 110-volt circuit. Leyden jars, spark gap, key and oscillation transformer. The sending set is on the top part of the table, except key.

The aerial is 50 feet long and 100 feet high and consists of two wires. I get very good results with this set.

ROYAL C. WEITH,

Chicago, Ill.

of open core type and employs a choke coil to regulate current. Referring to the photo: To the left may be seen the impedance. In the center is the transformer, and to the right the condenser, which is of glass plate type, immersed in oil. The oscillation transformer, which is of the double sliding pancake type, is secured to the table.

The rotary gap is of the Marconi type with rotating bar, carrying the two electrodes instead of the usual pin-wheel type. This gap has the advantage of starting quickly, and also keeps cooler than the wheel gap. Also the glass-front case containing the rotary is suspended by four spiral springs, which reduce the vibration of the motor to a minimum. We have transmitted 50 miles.

MONROE WAYNE,
A. ROSS WAYNE

New York City.

The most efficient way to recharge small storage batteries is by means of a small dynamo driven by water motor or gasoline engine.

RADIO STATION OF RAYMOND MYERS.

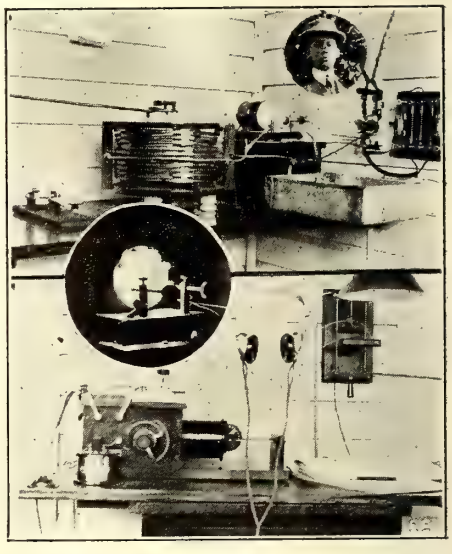
Below is shown the radio equipment of Raymond Myers, Tiffin, O. The sending set consists of Blitzen ¼-kw. transformer, oscillation transformer, rotary gap and an oil-immersed glass plate condenser. The receiving set includes a navy type receiving transformer with dead end switches, Murdock variable and fixed condensers, galena detector and Brandes' 2,000-ohm phones. The aerial is 40 feet high and 120 feet long, composed of four antenium wires on 11-foot spreaders.

With this outfit I have heard all of the near-by lake stations and a great many along the Atlantic Coast south to NAX. Have picked up amateurs this winter from Buffalo, N. Y., to St. Louis, Mo., a few being 8KP, 8BC, 8EG, 8OZ, 9EE, 9EG, CHW, 9BD and have heard 9YN on several occasions. In sending I have been heard 200 miles away and talked with a score of amateurs within a radius of 75 miles. Time and weather reports are received daily at this station from NAA and NAR, and with loading inductances connected in circuit WSL clearly responds.

A Radio Club has been organized in this city, and I would be glad to hear from any amateurs who would like to join. I have a Government radio license (second-grade amateur), and my call letters are 8CT.

RAYMOND MYERS,

Tiffin, O.



Top Photo Shows Mr. Myers and His Sending Set. Center: Rotary Gap. Below: Receiving Station.

TECH WIRELESS CLUB NAMES NEW OFFICERS.

The Tech Wireless Club of Harrisburg, Pa., has elected these officers: President, Prof. Peet; vice president, Prof. Loomis; secretary, Charles Everett Kutz; treasurer, G. Webber Knight.

Besides some minor pieces of apparatus the club will add a new aerial to its equipment this year. The aerial will be in the shape of an angle, one side of which will be seventy-five feet and the other side sixty feet. The apparatus will be greatly increased in strength and the members expect to get into communication with Lehigh University.

ROCKWELL RADIO LABORATORY.

It certainly is a great idea to incorporate in your fine magazine, *The Electrical Experimenter,* such a contest as the "Amateur Radio Station Contest" is bound to be. Enclosed you will find a flashlight of my wireless and experimental station, and also a photo of myself, which I wish to enter in this contest.

In my receiving circuit I have a loading coil, an E. I. Co.'s loose coupler, a variable condenser, a blocking (fixed) condenser with controlling switch; a potentiometer which controls the current to my E. I. Co. electrolytic detector, and also to my carborundum detector; an E. I. Co. Universal detector stand, using galena with two 2-point switches to throw in either detector with or without potentiometer; a Junior fixed condenser across phones with controlling switch, and 3,000-ohm phones.

On my sending side, I have a 1-inch spark coil which is operated by a transformer which reduces the street alternating current down to eight volts; an E. I. Co. wireless key; a zinc spark gap, sending Helix and a Leyden jar condenser.



Left: Donald P. Rockwell.

Below: His Complete Wireless Sending and Receiving Apparatus.



My aerial is of No. 14 wire, about 120 feet long, of 4 strands, 60 feet high at one end and 40 feet high at the other end.

My ground is a ¾-inch pipe driven 8 feet into the ground. The receiving set has a range of from 1,200 to 1,500 miles, and the sending set a range of from 6 to 8 miles.

In my station I have, besides my wireless set, a telephone and a telegraph, both of which I use in communicating to different friends about the city. In the telegraph circuit I have a sounder, a relay and a key. In the telephone circuit is a receiver and a Stromberg-Carlson transmitter.

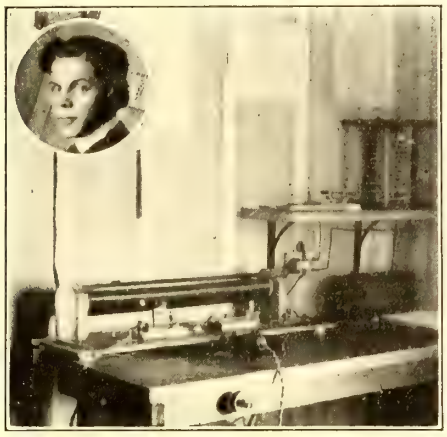
DONALD B. ROCKWELL,
17 Walnut St.,
Wellsboro, Pa.

The efficiency of wireless transmission over long distances is very low owing to the scattering of the waves in all directions. Probably the average energy received from a transmitting station is but one one-millionth part of the initial power radiated.

RADIO INSTALLATION OF J. L. TAYLOR, JR.

I have an efficient wireless station and give you a photo of same, as well as one of myself.

The receiving set consists of double slide tuning coil. Universal crystal detector, Murdock loading coil, 8-point variable fixed condenser and Murdock 1,000-ohm single headset. I also have buzzer test. I hear N. A. A., W. C. C., N. A. D., W. S. L. and many other nearby radio stations.



Mr. J. L. Taylor, Jr., and His Radio Station.

My sending set consists of Mesco key, 1-inch spark coil, spark gap, suitable condenser and oscillation transformer.

Aerial is 65 feet long, consisting of four wires spaced two feet and supported by pole 50 feet high. Lower end of aerial is about 30 feet high and fastened to roof of house.

The ground is an iron pipe driven into ground about seven feet.

I have an amateur's license and also station license. My call is "8 W. S." On the whole, I am quite pleased with my set.

I read the *Electrical Experimenter* and enjoy it very much.

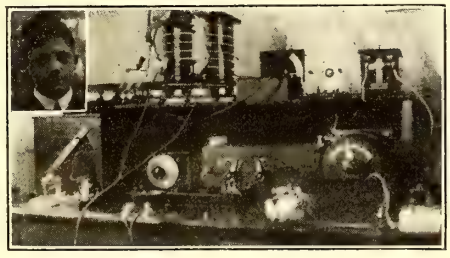
J. L. TAYLOR, JR.
Barker, N. Y.

PALMER HILL'S AMATEUR STATION.

Below is a photo of my wireless station, which I would like to enter in your wireless station contest.

The sending apparatus consists of a one-inch spark coil, rotary gap, home-made condenser and helix, key and hot wire ammeter, also a rheostat for gap.

Receiving set as follows: Clapp-Eastham and E. I. Co. loose couplers, large, home-made loading coil, fixed condenser, switch box, loading inductance, Var. condenser, galena detector and others for experimenting with different substances, aerial switch and Government receivers.



Palmer Hill's Excellent Wireless Outfit.

Most of the instruments are of standard make, which I find very efficient. The aerial is 50 feet long, composed of six wires, 40 feet high, of the inverted "L" type. I am going to erect a six-wire aerial 300 feet in length for receiving purposes.

I hear all the coast stations from N A B to N A R; also, on Friday, Jan. 8, 1915, between 9 and 10 p. m., I heard wireless telephone messages and music.

PALMER HILL.
Stamford, Conn.

C. L. Robinson, of Laquey, Mo., writes us as follows:

"I received the April *Electrical Experimenter* which I wrote you about and thank you very much. I am very much delighted with your magazine. I have read several but it is the best I ever saw for the general Electrical and Wireless Experimenter. Success to you."

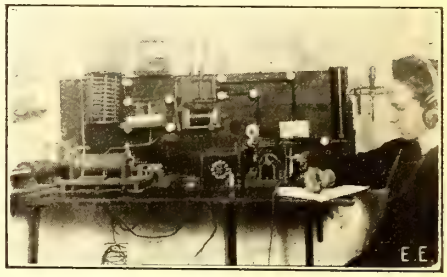
FLINDT STATION.

The following is a description of my radio station:

Transmitting: One and one-half inch spark coil run on eight dry cells, volt and ammeter for testing, wireless key, Helix and spark gap. I use a high-tension glass plate condenser; wave meter for regulating wave length. I have a range of 10 miles with this apparatus.

Receiving: Loose coupler with variable condenser across primary. I employ a condenser and detector in secondary circuit. Phone 2,000 ohms resistance.

A loading coil is in series with aerial.



Radio Messages "Coming in" at Walter Flindt's Station.

Double-pole, double-throw switch connects either sending or receiving circuit. My aerial is 80 feet long and 60 feet high with four wires. Have caught stations as far as 800 miles away at night.

WALTER FLINDT.
Philadelphia, Pa.

NEW AMATEUR RADIO STATION AT GARDINER, ME.

The new wireless station installed by F. H. Woodbury, was given a tryout recently and worked perfectly. Many messages were picked up from incoming ships and places all along the coast and the receiving apparatus worked exceptionally well.

Considerable credit is due the men of the Central Me. Power Co., who did the work of establishing the aerials. The work was made difficult because they are stretched from two poles fastened on the peaks of two buildings with slanting roofs of slate that made the work somewhat hazardous as well as difficult. One expert who has seen similar installations says that it is one of the best jobs he ever saw. It is the efficient way in which this work was done that is largely responsible for the perfect working of the apparatus, undoubtedly.

The prime object of the apparatus is to get the correct time from Washington.

QUESTION BOX

This department is for the sole benefit of the electrical experimenter. Questions will be answered here for the benefit of all, but only matter of sufficient interest will be published. Rules under which questions will be answered:

1. Only three questions can be submitted to be answered.
2. Only one side of sheet to be written on; matter must be typewritten or else written in ink, no penciled matter considered.
3. Sketches, diagrams, etc., must be on separate sheets. Questions addressed to this department cannot be answered by mail.

RECEIVED RADIO ENERGY.

(273) Ralph L. Kunau, Sabula, Ia., asks several radio questions.

A. 1. We would suggest that nothing smaller than No. 16 B. & S. conductor, either solid or stranded, such as lamp cord, should be used in wiring up a radio receiving set. No. 22 to 24 B. & S. wire is used considerably for tuning coils.

The voltage of a received current on a wireless aerial over medium distances where the signal is strong is of course very minute. It is probably on the order of one hundred-thousandth of a volt. Under ordinary conditions, using a crystal detector with high resistance head phones, etc., the current necessary in the aerial for good, readable signals is about 40 micro-amperes. Signals are rather hard to read when the current drops as low as 10 to 15 micro-amperes. Of course, when amplifiers are used, the current may be many times weaker than here mentioned, and the signals will still be readable. An experimental potentiometer may be made from a pencil as you suggest.

WAVE LENGTH MEASUREMENT.

(274) Mr. S. H. H——, Cleveland, Tenn., sends several radio wave length queries.

A. 1. In regard to your aerial wave length and your wave meter, etc., would advise that as long as you have a wave meter of the Clapp-Eastham type you should have no trouble in finding out just what adjustments you have in your circuits as to wave length values, etc.

After looking over your question carefully, it appears that either the capacity or the inductance in the closed oscillating circuit must be reduced, if you are to radiate energy at 200 meters wave length. We believe that in your second case that the wave meter has been placed too close entirely to the excited system of the aerial. This, of course, would account for the fact that you could hear the signals in the wave meter receiver all over the condenser scale. In using the wave meter in every case, it must only be placed just close enough to the wireless transmitting set so that the faintest signal can be heard nicely at the point of maximum resonance in the wave meter. This point is found by turning the condenser handle back and forth.

The editor of this column, from some experience in the matter, always prefers when possible, or when tuning transmitter sets, to make use of a small low-voltage battery lamp or a small Geissler tube connected across the condenser terminals of the wave meter as a resonance indicator in place of a telephone and the detector. Undoubtedly, when you get your two oscillating circuits properly joined together or in perfect resonance, you will be able to transmit 80 to 100 miles easily with your 12-inch spark coil and electrolytic interrupter.

RADIO QUERIES.

(275.) Rudolph Fehnle, Moballa, Ore., asks the question department several radio questions.

A. 1. A double head-phone set is always preferred to a single receiver, as the joint action of two 'phones acting on both ears simultaneously gives a much better effect acoustically than when only one is used.

When tuning coils are used for loading purposes they are simply connected in series with the aerial lead-in, one wire being joined to the end of the coil proper and the other wire to one of the sliders.

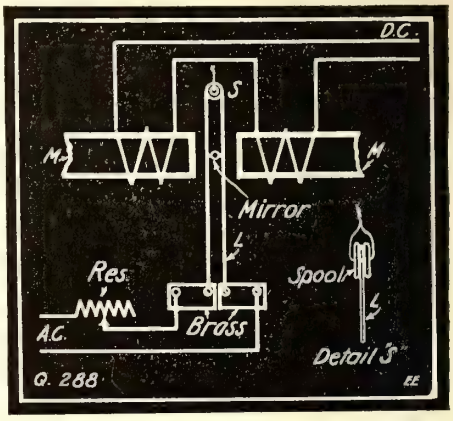
We do not suggest sand-papering enameled wire on tuning coils, except where the slider is to make contact. The capacity effect of enameled wire insulation is of small import, generally speaking.

OSCILLOGRAPHS.

(275 A.) Oscar P.——, 825 Roscoe street, Chicago, Ill., is interested in the operation of an oscillograph for tracing the curve of alternating wave form, time-circuit values, etc.:

A. 1. The sketch shows simply how the oscillograph works, and the current of which a record is desired is passed through the looped wire shown, which is supported in a powerful magnetic field, produced by direct current excited magnets MM.

The looped wire L can be of fine platinum (say .0005" dia.), and it passes around a small spool-shaped suspension, as sketch shows, the spool being hung on a fine quartz fiber preferably. Between the wires is supported a miniature metallic mirror, which reflects a beam of light on a moving strip of photographic film. After a record has been taken the film is developed as usual. The film compartment is, of course, light-tight and the fluctuating current passing through the loop L causes the moving mirror to trace a line of the wave form, etc., on the moving film. A suitable resistance should be connected in series with the element L, of course.



The Principle of the Oscillograph.

It is possible to build one of these machines cheaply with a little care, but the commercial machines are rather expensive and generally cost in the neighborhood of several hundred dollars.

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The owners of these things wish to ***"swap"*** them for **something else, something which you may have.**

The Rates

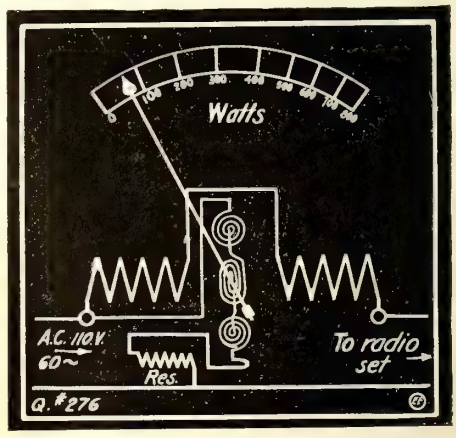
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WATTMETER HOOK-UP.

(276.) James W. H.——, New York City, wants connection diagram for Weston type direct-reading wattmeter in a wireless transmitting circuit.



Watt-Meter Connections in Radio Transformer Circuit.

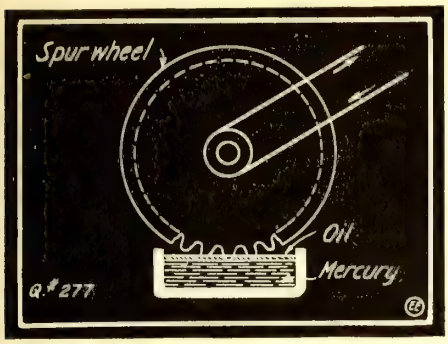
A. 1. Diagram is given herewith for connecting a direct-reading wattmeter in on 110-volt A. C. wireless transmitting sets.

LODGE MERCURY COHERER.

(277.) Sumner B. Young, Dorchester, Mass., inquires as to the construction of the Lodge mercury coherer:

A. 1. In the mercury coherer of Lodge's pattern a toothed wheel is caused to rotate by clockwork, etc., over a small mercury pool. Over the mercury is placed a thin film of oil such as machine oil, and the coherer is so adjusted that the teeth of the brass wheel just barely touch the mercury. The sketch shows the arrangement of this device in this case.

The incoming etheric wave currents break down the slight insulating film between the teeth on the wheel and the mer-



The Lodge Mercury Coherer.

cury, thus allowing more battery current to pass through the coherer to the signaling instrument. The oil helps to restore the coherer to its normal state. This coherer is therefore "self-healing."

TOPOGRAPHY VERSUS WIRELESS.

(278.) F. W. Noel, Boswell, Pa., asks us about height above sea level in respect to wireless work:

A. 1. The height of your location above sea level has no appreciable effect on radio operation, generally speaking. What we mean to say is that persons living at very high altitudes and those living in valleys several thousand feet lower use practically the same aerial dimensions. It is considered best, however, when a choice can be had, to erect the aerial on the highest point of land available.

You should be able to get the Arlington Time Signals at your location, 200 miles from Washington, with a good receiving outfit, providing your aerial has a fair length. The length should be preferably from 100 to 150 feet, but you may try your 55-foot length aerial before increasing same if desired.

TELEPHONE RECEIVER NEEDS REMAGNETIZING.

(279.) Philip C. Platt, Bridgeport, Conn., writes regarding a telephone receiver which has apparently become demagnetized:

A. 1. Most probably you had best return the receiver, which has its magnets weakened, to the makers for remagnetizing.

A. 2. Rotary spark gaps are used a great deal with spark coils, but unless some synchronous form of interrupter or commutator is used in connection with the rotary gap it is very difficult to get a pure tone from the outfit. Quenched spark gaps are generally found best for use with spark coils, no matter whether the coil is interrupted in the primary circuit by a vibrator or electrolytic interrupter. The above consideration will be evident to you very plainly upon analyzing the action of such interrupters, which is very unsteady or variable as to frequency.

LOOSE-COUPLER SWITCHES.

(280.) William Neckerman, West New York, N. J., wants to know how switches can be connected to loose-coupler primary so as to cut out one of the tap switches where desired:

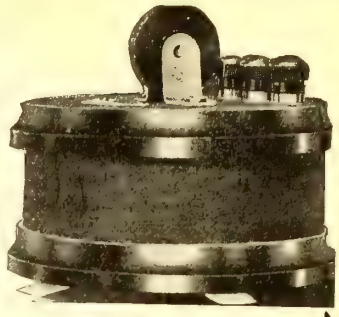
A. 1. You can divide up the winding as you mention on the large loose coupler and simply place a two-point switch "S," as shown in diagram, to quickly cut out about half the winding or other parts of it in one step as desired for rapid change of

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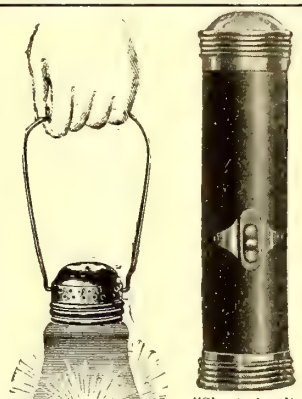
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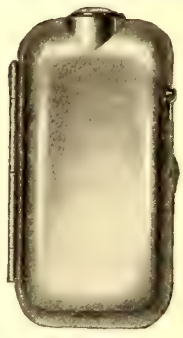
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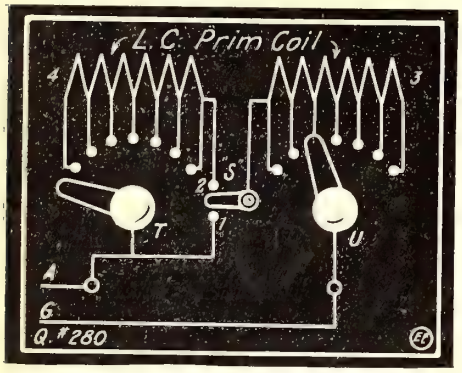
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wave length. By the arrangement here shown you also gain a great deal, as when the switch "S" is on point 1, and switch



Switching Scheme for Loose Coupler.

"T" is opened or placed on the dead point, there will not be an undue loss from distributed capacity in the idle turns of the coil.

INDUCTION COILS ON A. C. TRANSFORMERS.

(281.) Frank S. A.— —,Easton, Md., states he cannot get his induction coil working right on a step-down A. C. transformer:

A. 1. We do not know how you are attempting to use your spark coil in connection with the small A. C. transformer of the step-down type.

However, we may state that in every case such as this the spark coil vibrator is, of course, used the same as if a battery were employed. Otherwise you will get no results at all, as the low voltage A. C. has too smooth a sine wave form to give any results in the spark coil, and the vibrator must be used to give a sharp break in the circuit.

The statement you make is incorrect regarding the passage of an alternating current through any coil which has an iron core within it. Any transformer ever used, practically speaking, has, of course, its proper iron core, and alternating current is used in all of these transformers throughout the country for lighting and power work, for wireless stations, etc. The current in the ordinary spark coil, using batteries for excitation, is really an unsymmetrical alternating current, as has been proved by oscillographic tests in the laboratory.

DICTAGRAPHS FOR DEAF PEOPLE

(282.) E. I. C.——, Lexington, N. Y., writes us regarding a special model dictagraph which he has purchased for helping him to hear better, and which does not help him as expected:

A. 1. The editor of this column has known of a number of such cases and, in fact, has been personally familiar with a couple of cases where such instruments as the dictagraph did not prove of benefit at the first trials of same. This is due probably to the fact that such an instrument gives forth rather a harsh sound in reproducing the speech at first to a person who has never heard it in operation before; therefore speech is not always fully intelligible. We believe, however, if you try this instrument daily for a week or more that you will soon become accustomed to it and that it will help you. Most companies do not, however, make any positive guarantee at all that this instrument will absolutely in every case help those hard of hearing to hear perfectly. This is because every case of deafness or partial deafness

(*Continued on page 73, first column.*)

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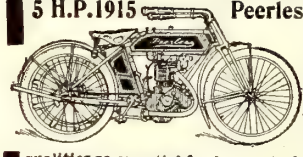


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BARON MÜNCHHAUSEN'S NEW SCIENTIFIC ADVENTURES.

(*Continued from page 43.*)

me, while tears of gratitude ran down his ruddy cheeks. We then discussed the details, and next morning we put the whole plan before the Government. The President and his Cabinet, General Sir John French, of the British army, as well as King Albert, of the Belgian army, were even more enthusiastic than Joffre had been, and a vote was passed immediately authorizing me to go ahead with the work.

"So cautiously did we proceed that no German spy ever got wind of the great scheme. No suspicious character was allowed to come within 10 miles of the tunnel openings and, as the latter were cunningly started under large railroad sheds, reconnoitering aeroplanes of the enemy never suspected what was going on beneath.

"There were four large tunnels all told. The first started at a point near Pont-à-Mousson, ending in the forest of La Fourasse. Another one started not far from Verdun and ended in the forest of the Argonne. No blasting or dynamite was used for fear of arousing the Germans overhead; each tunnel was large enough to enable 20 men to march abreast in it upright.

"At the end of December, 1914, we had over 150,000 men at work on the four tunnels, and by February 1, 1915, they were completed except for a few yards at the far end. During that night the entire French as well as British and Belgian armies walked into the tunnels—men, horses, automobiles, artillery and all. We had burned our bridges behind us; everything was staked on the *grand coup*.

"A small opening was then made carefully at the end of each tunnel, and one of our men cautiously emerged through each small hole. Each of the four reported the forests quiet, whereupon our sappers quickly broke out a large opening; within one hour our armies began to *debouche* from the tunnels, and by morning the four units had marched out of the four forests. One-half of the armies were to fall into the backs of the Germans and the other half were to march on Berlin. I was with the latter, highly elated at our success. We immediately seized all railways and roads, and our advance began.

"There was only one thing which disturbed us. By night we were informed that the other half of our legions which were to fall into the back of the enemy had failed to find a single German soldier. Neither Joffre nor I could understand this, but the next morning we had the glad tidings that our army had taken some 40,000 prisoners and that not a single German remained. Joffre and I naturally reasoned

(*Continued on page 73, second column.*)

(*Continued from page 72.*)

is different, and some require surgical or other treatment.

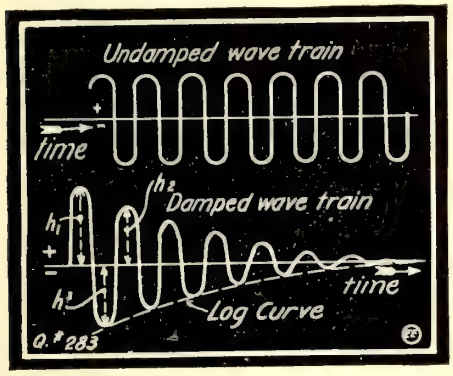
DAMPED AND UNDAMPED WAVES.

(283.) Blair Mudgett, Johnstown, Pa., asks for explanation of damped and undamped radio wave phenomena:

A. 1. The curves here shown will give you an idea as to what is meant by the damping of radio waves. As you will perceive, these waves gradually but surely fall off to zero amplitude. This considers, of course, a damped or spark wave, and not an undamped wave, such as that developed or produced by an arc generator, for instance.

The damping of the waves as here outlined takes place in accordance with the rule of logarithmic decay—that is, the peaks of various successive waves or positive and negative ripples follow a logarithmic curve as perceived from sketch.

By logarithmic decrement is meant a certain amplitude value of one successive wave as compared with the preceding. The Government radio law now in effect stipu-



Difference Between Damped and Undamped Wave Trains.

lates that the ratio between the amplitude of the first wave and the second half wave following it shall not exceed 2-10 when these two amplitude values are compared with a Naperian logarithmic base. In practise this logarithmic decrement is always found with a decrementer such as the Marconi or Kolster type.

The logarithmic decrement in Germany and the United States considers the value of decrement as equal to the Naperian logarithm of the term (height of wave h1 divided by height or amplitude of wave h2). In England the decrement is expressed as Nap. log. of h1 divided by the next half wave amplitude h3. Hence the U. S. value is found by multiplying the English text-book value by 2.

A log. decrement of .2 is equivalent to 12.5 waves in the train before the amplitude "h" falls below one-tenth of the maximum. Good tuning cannot be done if there are less than about 15 waves in the train. Hence the law stipulates a decrement of not more than two-tenths.

THE SEPARATION OF STEEL AND COPPER FILINGS.

Put some fine copper and steel filings on a piece of paper. By passing an electric spark from an induction coil through them the filings will be found separated. Arrange very fine copper filings on a sheet of paper. It will be found that one electrode only will attract the copper filings, the other electrode remaining inactive. If for copper filings we substitute powdered plumbago on glass we shall find a decided repulsion ensuing.

(*Continued from page 72.*)

that the Germans had held their western trenches largely by bluff, while their real army, consisting of several million soldiers, had been thrown against the Russians to hold the latter back from East Prussia and their new invasion of Hungary.

"We therefore pressed forward with great speed, using Germany's wonderful strategic railroad system for the main advance.

"On February 5 our allied armies had crossed the Rhine at Cologne, Koblenz and Mayence. On February 10 we crossed the Weser, and on February 20 we entered Berlin triumphantly, without a shot having been fired. It was almost too good to be true, but more work lay ahead of us. Our mission was only half filled. We had not as yet conquered the main German and Austrian armies, which we knew to be on the eastern frontier, and no victory can be complete as long as a powerful army remains in the field. In accordance with this, we began pressing forward again, when we were dealt a most terrible shock.

"We received the awful intelligence from our army which we had left behind (in order to patrol the conquered territory) that one and one-half million Germans were rushing on us with forced marches *from France!*

"We were dumfounded. Was it a trick or a hoax?

"Alas, it was neither. I will not bore you to death with a most unfortunate, heart-rending tale. This is what happened:

"Some German had hit upon the same idea as I had, but instead of boring four tunnels they bored but two. That was the only difference! While we thought we emerged behind their backs, they thought they were doing the same thing in reference to us. By a strange coincidence they marched out of their tunnels during the same night as we marched out of ours *and, while we captured Berlin, they captured Paris and then Bordeaux!*

"Not finding our armies (which they thought had retreated into the interior), they feared a trick and rushed back till they came upon the other half of our army stationed along the Rhine. Then they knew the truth.

"A curious state of affairs had, therefore, arisen in this terrible mix-up:

"We held Germany and a part of Austria, while the Germans held nearly all of France! Neither of us had gained any advantage, so we called a truce and agreed to trade back our present trenches for our former ones, while they agreed to take back theirs.

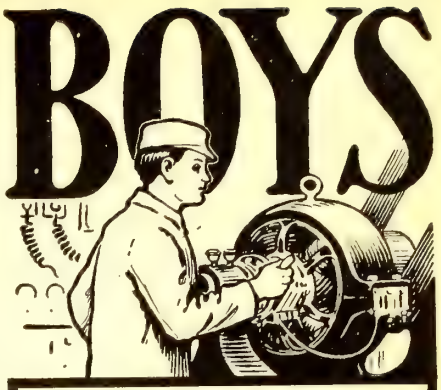
"For this reason March 1, 1915, found us in exactly the same position we had left on February 1, 1915, with the difference that for two days the Kaiser had been in Paris, while Joffre and I had been in Berlin!

"I immediately fell in disgrace with the Allies and I thought it best to take myself out of the way, which I did."

Baron Münchhausen took a long breath at this juncture, so I commented:

"This is certainly a most remarkable story; but, my dear Baron, how is it possible that we have never heard a single word about this momentous phase of the war? No newspaper ever mentioned a word about it, to the best of my knowledge. How can you explain that?"

"My dear boy," Münchhausen replied wearily, "evidently you have not been in Europe during the war. The explanation lies in the one word: Censorship! The Allies while marching on Berlin allowed no news to leave the country for fear that the German and Austrian armies at the Russian frontier would hear about it too early, so they naturally kept quiet."



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"But, your Excellency," I broke in, "how could that have helped you? As you advanced from town to town in Germany the Germans certainly must have had plenty of time to send word ahead by telegraph to their armies at the Russian frontier that the Allies were advancing on Berlin. This does not look right, somehow."

Baron Münchhausen chuckled softly for some time before he replied:

"Ah, my boy, I knew you would ask this, so I kept it until the last. The failure of the Germans in the East to receive news of our invasion was entirely due to a brilliant ruse of mine, studied out long before our entry into Germany. Like all my successes, this one was the simplest of them all. Ridiculously simple! I must laugh every time I think of it!

"You see, when the Allies emerged from the forests that night they were all of them, down to the last soldier, *attired in German uniforms!!*

"As large bodies of German soldiers were thrown back and forward over the great German railroad system so often during the war no one thought anything of our invasion, thinking us, of course, as Germans all the while; as a matter of fact, *over 80 per cent. of the German population never knew that the Allies had invaded Germany and Austria until we were back in our own trenches in northern France and Flanders.*"

Here Münchhausen indulged in an uproarious laugh before he proceeded:

"The fortresses which we encountered had so few men that we did not even bother to take them. Had the defenders found out during our advance on Berlin that we were not their compatriots they would have been powerless, as their numbers were pitifully small as compared with the immense armies of the Allies. However, they never suspected us. As we had naturally taken charge of all the telegraph and telephone lines immediately upon emerging from our forests, we sent, of course, fake war reports to Berlin all day long purporting to come from the front. The deception could not have been more complete. So you can readily see that all the 'news' which the Nauen wireless plant sent out broadcast each day over the entire world during the month of March was nothing but a hoax, manufactured expressly for it by our own General Staff!"

I was so stunned by this revelation that I sat speechless for a few seconds. But I collected my thoughts suddenly, and demanded:

"That is all good and well as far as it goes, but what about the German army in France, my dear Baron? How could over a million Germans have taken Paris and Bordeaux without the outside world hearing about it?"

I thought surely that I had cornered Münchhausen that time, but he merely gave a deep sigh and said sadly:

"Alas, great minds always run in the same channels. That German who thought of digging the tunnels underneath our troops also thought of putting *his* soldiers *into French and British uniforms!!*

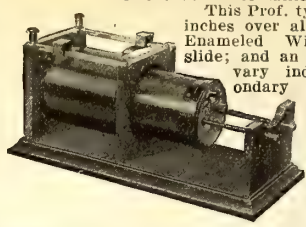
"So, you see, the German masqueraded armies fooled the French population precisely in the same manner as I fooled the German people with mine. There are thousands of French even to-day who have not the slightest knowledge that Paris or Bordeaux had been actually in German hands!! Think it over, and you can reason it out yourself how it worked. . ."

"And what did you do next, your Excellency?" I asked, more or less apologetically, for having doubted the Great Man's word.

"My last experience with the Allies having proved so humiliating to me, I did not wish to show my face in Europe any longer,

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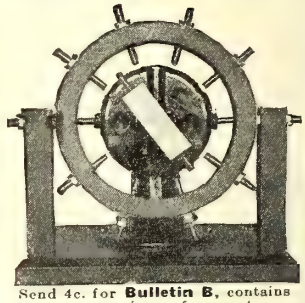
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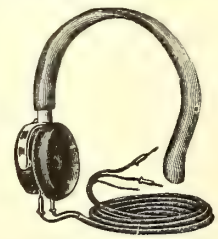
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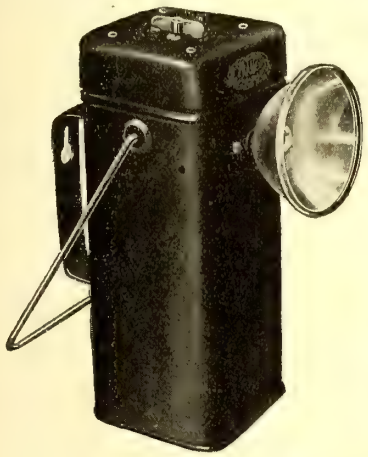
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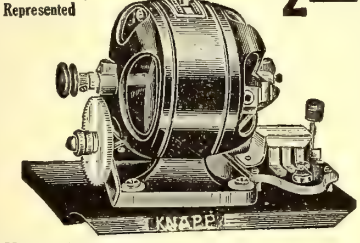
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so I decided to come to America, where I arrived in the middle of March. Having been in America previously, the country was not new to me; as a matter of fact, I had acquired some years before a large estate on the south shore of Long Island. To this I retired and, not having many friends in the neighborhood, no one bothered me much and I shortly completed my inventions on which I had been experimenting in Paris and which the war brought to an abrupt termination, as mentioned to you before.

"The problems of gravity had long attracted me most powerfully. With Newton, the famous, I wondered what made an apple fall from a tree or a brick from a roof. Newton long ago, in his famous works, had told us the *why*, but he had died without knowing the *how*. He knew all the laws governing gravity, but he knew not what the force consisted of. He was very much like Edison, who knows a great deal about electricity and its laws, but who does not know what electricity itself consists of.

"It did not take me a long time to actually solve the mysteries of gravity, once I hit upon the right track. I found that gravity, like electricity, is a certain manifestation of the luminiferous ether which permeates the universe and all matter.

"Once I had solved the mystery I set out immediately to find an insulator for gravity, and in a few days I had solved this problem in a masterful manner.

"To make myself plain: On earth all objects are attracted to the center of the earth by the force known as gravity. Whether it be a cannon ball or a feather, both will fall on the earth's surface if unsupported. If some means could be found to interpose between a falling apple and the earth a 'gravity' insulator, through which gravity could not act, the apple would stay suspended in mid-air, theoretically. It could not fall to the earth because there would be no longer any gravity to attract it.

"A parallel to the above is found in the following simple experiment: Take a steel ball and rest it on a smooth surface. Then take a strong horseshoe magnet. With it approach the steel ball; as soon as the magnet comes close enough the ball will roll toward the magnet till it reaches it. Separate the two again and repeat the performance, but before the ball reaches the magnet interpose a magnetic 'insulator' between ball and magnet—in this instance a stout piece of sheet iron. The iron will take up all the magnetism and no magnetic flux will reach the ball. Consequently it will lay still, unaffected by the strong magnet, which is just as strong as ever, but 'neutralized' by the piece of sheet iron.

"To go further: Before any form of energy can be transmitted from one point to the other it *must* pass through a conducting medium. Take the medium away and the energy cannot be transmitted any longer. To illustrate:

"Take sound, for example—a simple form of energy. A bell rings. The sound waves generated from the bell's gong travel through the air till they strike your ear drum. You hear the bell. In this case the air is the conveying medium. Take the air away and you can no longer hear the bell. Thus when a bell is placed under a glass globe you can still hear the bell. With an air pump now extract the air from the globe; you can still see the clapper of the bell strike the gong furiously, but you cannot hear a single sound, because you have taken away the conducting medium, the air.

"To go a step further: You look at the sun, some 93,000,000 miles distant from you. You see its rays, you feel its heat. Thus the sun sends a colossal amount of energy down to earth as well as to the other

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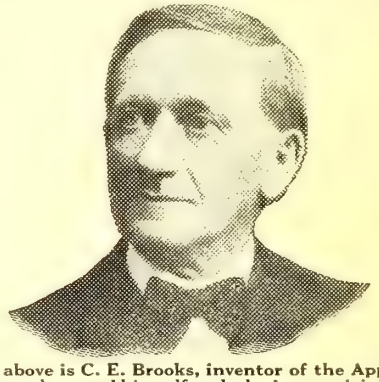
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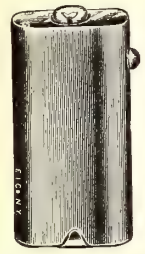
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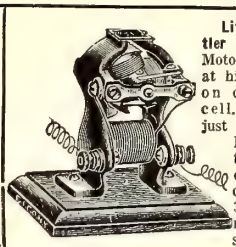
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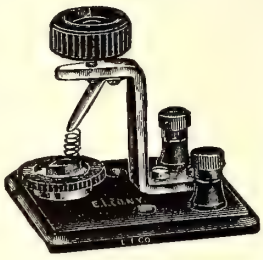
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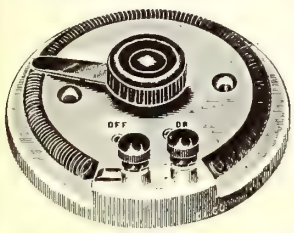
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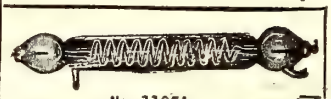


Rheostat Regulator. Resistance 10 ohms, finely adjustable. **Porcelain base,** air cooled. Capacity about 40 watts, 2 amperes rating. Fine for controlling speed of battery motors, electro-cautery work, dimming battery lamps, etc. No. 5000 rheostat costs 60c. Shipping weight 1 lb.

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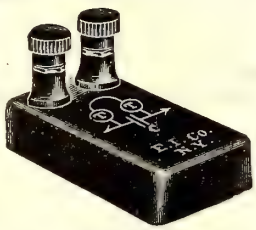
SEE NOTE BELOW HOW TO CALCULATE FOR MORE THAN ONE SUBSCRIPTION.



Geissler Tube, 3 inches long. Most beautiful tube you ever used on your spark coil. Several colors show. A ¼" or ½" spark coil lights tube nicely. Gives a very weird effect. No. 1125A Geissler tube sells for 30c. Shipping weight 1 lb.

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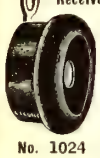
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Jr. Fixed Condenser. Hard rubber comp. case. Widely used in radio receiving circuits. Should be used with tuner, phone and detector here shown, etc. Cap. .0165 M. F. size 2⅝x1½ x1¼". No. 10010 condenser sells at 50c. Shipping weight 4 oz.

No. 10010

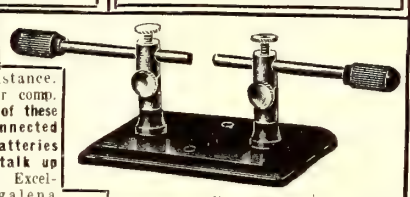
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Pony Telephone Receiver. Single pole, 75 ohms resistance. Hard rubber comp. shell. **Two of these receivers connected without batteries will carry talk up to 150 feet.** Excellent with galena detector for wireless. No. 1024 receiver, regular price 40c. Shipping weight 1 lb.

No. 1024

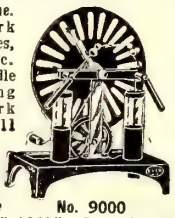
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Zinc Spark Gap, works on any spark coil. Can be used as an anchor gap or break gap in "break-key" systems. Zinc rods are 3/16" in diameter, and fitted with two insulated handles. Handsome instrument. Base is hard rubber comp. No. 9220 spark gap sells for 60c. Shipping weight 1 lb.

No. 9220

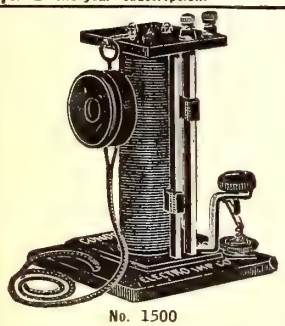
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Static Machine. Gives 3" spark without batteries, dynamos, etc. Simply turn handle and crackling blue-white spark leaps the ball gap. Two 7" Electrite plates. Lots of experiments available. Best machine made. Size 8x5x10½". Price $3.75. Shipping weight 6 lbs.

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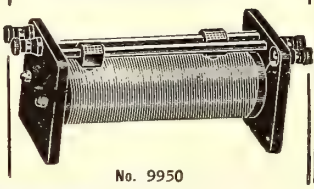
"Interstate" Wireless Receiving Set. Receives messages up to 300 miles on fair size aerial. Has tuning coil, detector, condenser and 75 ohm receiver. Hard rubber comp. base and top. No. 1500 Interstate set sells for $3.75. Shipping weight 4 lbs.

No. 1500

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No. 9950



1000 Ohm Wireless Receiver. Very sensitive. Single pole. Moulded shell. Steel magnet powerfully magnetized. Coil wound with enameled copper magnet wire. Well made throughout. No. 1024A 1000 ohm receiver sells at $1.00. Shipping weight 1 lb.

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NOTE—Your own subscription may be included in the above offers. If you are a subscriber already we will extend your subscription. Example: Suppose you desire the No. 9700 Galena Detector: you may get four friends, each to subscribe for 1 year; or three friends and yourself for 1 year; or two friends for 2 years; or two friends for 1 year and yourself for 2 years; or finally yourself for 4 years, etc., etc., whichever way you like.

Collect the $2.00 for us and the Detector is yours.

The Electrical Experimenter

Premium Dept. 233 Fulton Street New York City

planets. What is the necessary conducting medium here? The luminiferous ether, that mysterious fluid, so fine, so intangible that man has as yet never seen, nor felt, nor weighed it. Nevertheless, we have long known of its existence. It fills the pores of the densest metal as well as all space in the universe. There is no atom on earth or in the heavens which it does not permeate completely at all times.

"But of course this is all well known to you. I simply recite it so that the following may become plain to you:

"I take a glass tube five feet long, in which I place a piece of cork. Then I exhaust all the air from the tube. When I turn the tube upside down the cork will, of course, fall from the top of the tube to the bottom. Through what medium does the energy of gravity pass to reach the cork and force it to fall down? The ether. I now take my gravity insulator, place it between the tube and the earth and turn the tube upside down. What happens? The cork no longer falls down, but stays on top; furthermore, the entire tube, cork and all, 'floats' in the air when my hand releases it. Gravitational force cannot reach the tube. It is 'insulated,' the same as glass insulates electricity and prevents it from leaving its conducting wire.

"My gravity insulator is simply a curiously arranged wire netting of insulated *Marconium* wires crossing each other at right angles. Marconium is a certain metal of the rubidium group discovered by me; a netting of this wire, when excited with a powerful current of a peculiar wave and a frequency running into the millions, acts as a perfect insulator toward gravity BECAUSE IT NEUTRALIZES THE ETHER ABOVE AND BELOW IT. When placed above the ground you can pile tons of metal or stone or any other material over it. It will not touch the gravity insulator unless you push it down on it by applying an external force to it. The material cannot drop on the insulator by its own weight because NOTHING HAS WEIGHT IN SPACE, WHERE THERE IS NO GRAVITY.

"To prove this axiom I placed a spring scale over my gravity insulator. The scale stayed, of course, suspended as soon as I took my hands away from it. Now I placed weights on top of the scale, starting with a one-pound weight. The scale registered no weight, even when I increased the weight to 100 pounds. Under normal conditions my weights would have tipped the scales to 100 pounds. On top of the 'insulator' the 'weight' had vanished, the same as the sound of your bell will vanish, when you place it in a vacuum. In order that you will not draw any wrong conclusions, let me state explicitly that the *etherless zone is confined only to about one inch above and below the Marconium wire netting.* Thus any object placed above the 'insulator' is, of course, surrounded by ether *else you could not see it.* But gravity on earth (unlike ether) acts only in a straight line, this line passing through the center of the earth.

"For this reason objects placed above my 'insulator' will only stay suspended if placed directly above it. If a part of the object extends over the edge of the netting the object will fall down on the netting, because gravity will pull down on the 'exposed' part of the object. In order to carry out these experiments successfully it is quite necessary that the sun, as well as the moon, are quite below the earth's horizon. If this precaution is not taken the object above the 'insulator' will be attracted immediately toward the sun or toward the moon unless another gravity insulator is placed *above* the object to neutralize the sun's or the moon's gravitational attraction.

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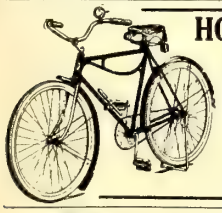
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"My invention completed, I immediately set to work toward building a machine which would enable me to leave the earth. I accordingly constructed a very strong steel globe about 60 feet in diameter, which was to take me out into space, my first planned excursion having for its object our nearest neighbor in space, the moon, only 240,000 miles distant.

"The steel globe which was to take me to the moon has its entire outer surface covered with a double Marconium netting, the free, insulated wire ends of the netting entering the globe, where they are connected to an elaborate switching arrangement.

"Running around the globe's circumference—its 'equator'—a wide belt or track is provided. This is the 'landing' track; on it the globe can readily roll over the ground without damaging the Marconium wires underneath. This track is also made of Marconium and is carefully insulated from the rest of the globe. The interior of the globe is well furnished for all comforts and has a powerful electric plant, similar in many respects to a modern submarine power plant.

"After having completed all arrangements, having stocked the machine with all kinds of provisions, fuel and many scientific instruments and apparatus, I made ready to leave old Mother Earth. The trip proving to be extra hazardous, I took only one person along, an intimate friend of mine, Professor Hezekiah Flitternix, of Columbia University.

"The only other animate passengers of the expedition were Buster, my fox terrier, and Pee-Pix, the Professor's canary bird, which he refused to leave behind.

"The moon being full and almost overhead, we entered my machine, which I had christened the evening before as *'The Interstellar.'* The heavy, soft, rubber-lined steel doors having been screwed up airtight, in order that our air should not be drawn out once we were in the open space, I started the generating apparatus. I switched on the Marconium wires which covered the outer surface of the *'Interstellar,' but only that section which was turned toward the earth.* The other half of the netting turned toward the moon was not switched on.

"Through the glass portholes at the bottom of the machine we could see the Marconium wires glowing in their characteristic green glow. Immediately we were lifted toward the moon overhead at a frightful speed. In less than 90 seconds the entire American continent became visible, and in a few more seconds the earth in its true form as an immense globe stood out against a pitch-black sky.

"As light cannot pass through an excited Marconium netting, it was necessary to switch off the current for a few seconds, every time we wished to see earth beneath us.

"The upper part of our machine (turned toward the moon) was now subjected to the moon's gravitational attraction—the earth, on account of the machine's other half being gravity-insulated, no longer attracting it. We were, therefore, 'falling' toward the moon at a constantly increasing speed and—"

At this juncture I heard Münchhausen curse roundly and his voice became indistinct. I barely made out the words: "Power low—tomorrow, 11 P. M.——" then the peculiar screaming sound in my phones, running down the scale; the low click, then everything quiet. . . . . .

The next story is entitled
"Münchhausen on the Moon."



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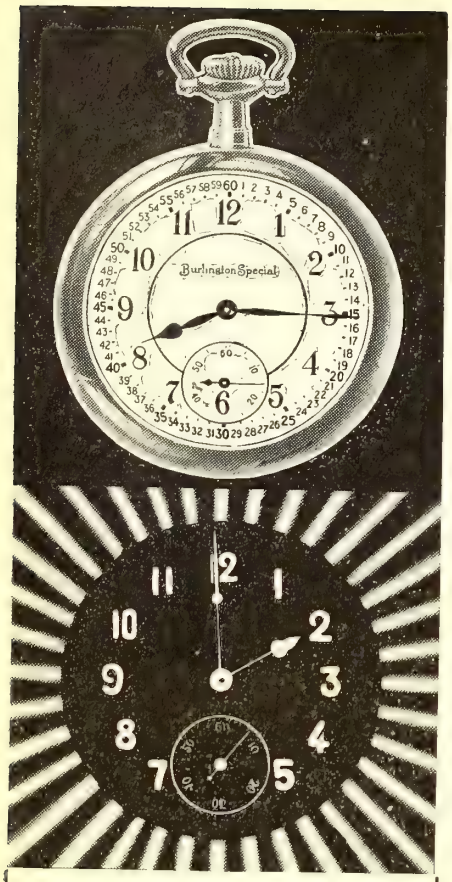
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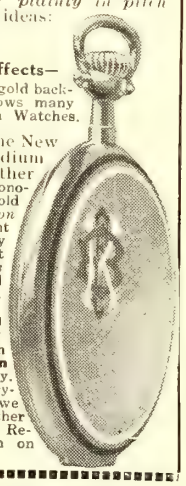
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Please send me (without obligations and prepaid) your free book on watches, with full explanation of your cash or $2.50 a month offer on the Burlington Watches.

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POLYTECHNIC ELECTRICAL ENGINEERING SOCIETY.

The Electrical Engineering Society of the Polytechnic Institute of Brooklyn held its annual affair on April 23 at the institute building. Dr. Clayton H. Sharp, of the Electrical Testing Laboratories of New York, gave an interesting lecture on "The Effects of Color and the Modern Development of Electric Illumination."

Illumination by electricity was first introduced by Thomas A. Edison in 1880. His lamp filament was made from charred bamboo strips, known to the trade as carbon filament. The glowing filament produced a yellow light. The efficiency of this lamp was about seven watts per candle. The efficiency of the original Edison filament has been increased to four watts per candle. From 1880 to the present time a variety of filaments have appeared in the illumination field, such as squirted cellulose, 3.1 watts per candle; metallized carbon, 2.5 watts per candle; tantalum, 2 watts per candle; squirted tungsten, 1.25 to 1.5 watts per candle; drawn tungsten, 1 watt per candle, and drawn tungsten in a nitrogen-filled atmosphere, consuming .5 to .8 watts per candle. Dr. Sharp then showed five booths, each containing the colors of the spectrum in cloth fixed in a slanting position from the top and a piece of brown plaid cloth in back of the booths. The first booth was illuminated by a four-watt-per-candle Edison carbon filament lamp and the last booth was illuminated by a .5 to .8 watt drawn tungsten filament in a nitrogen-filled atmosphere. The blue cloth varied in color from a pale blue in the first booth to a dark blue in the last booth, while the plaid changed from a bright red in the first booth to a dark brown in the last booth.

After Dr. Sharp's interesting lecture everybody adjourned to the gymnasium for the dancing.

RADIO CLUB OF AMERICA MEETING.

The Radio Club of America, one of the latest and rapidly growing wireless societies, held its May meeting at Columbia University on the first of the month.

The evening was taken up with the reading and discussion of two excellent papers by Mr. Paul F. Godley. The titles of the papers were "The Measurement of Intensity of Received Radio Signals" and "Radio Activities on the Pacific Coast."

Mr. L. G. Pacent presided as chairman, and Mr. P. Johnston, secretary of the club, also had a few words to say. The discussion was opened by Mr. Harry Sadenwater, radio inspector for the port of New York, and several other members present contributed to the discussion. Among prominent members present were: Mr. Fritz Lowenstein, consulting radio engine r; Mr. Alfred P. Morgan and Mr. Walter Lemon.

A complete audion receiving set with several bulbs for producing beats was demonstrated and signals from San Francisco were heard plainly. Stations up to 800 miles and more away were heard by means of the audion amplifier and horn all over the lecture room.

The General Electric Co. is building a high frequency wireless alternator to yield 50-75 kilowatts at 50,000 cycles. These are to be compared with the 75-100 K. W. Poulsen arcs now in use for long-distance radio work.

Avoid touching radio detector crystals with the fingers, as oil from the skin adheres to the crystal, thereby reducing its sensitiveness.

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Burns Lava Fuel—Alcohol Solidified

No liquid to spill or explode. No bulky bottle, no wick, no smoke, no odor. Saves trouble and time many times a day. Has no equal for cooking a hasty meal, heating a chafing dish, boiling water, warming baby's milk, heating curling irons; invaluable for campers and travelers.

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Opportunity Exchange

YOU will probably find more opportunities and real bargains in these columns than anywhere else in the country. Most good things in life are hard to find and worth going after—these little ads illustrate that point; you alone will be the real loser if you don't take the time to scan through these columns.

Advertisements in this section 4c. a word for each insertion. Count 7 words per line.

Name and address must be included at the above rate. Cash should accompany all classified advertisements unless placed by an accredited advertising agency.

Ten per cent. discount for 6 issues, 20 per cent. discount for 12 issues from above rate. Objectionable or misleading advertisements not accepted.

Advertisements for the July issue should reach us not later than June 5th

EXPERIMENTER PUBLISHING CO., INC., 233 Fulton Street, New York, N. Y.

BOOKS

"TRAFFIC in Souls." This book is based upon the most widely discussed motion picture production. It is a powerful study of vice conditions in New York, and the facts upon which it is based were compiled from the Rockefeller White Slave Report. Illustrated with striking photographs. 300 pages. Send prepaid for 60c. Hesse Mercantile Co., 12 East 22d St., New York.

360 POPULAR Toasts. Selections for all occasions; just what you need at an evening party, 10c. Wedge Manufacturing Co., "Km.," Binghamton, N. Y.

"HUNDRED Ways to Kiss a Girl" and other things. Something real good. Price 25c. Bronx Girls Club, 417 E. 151st St., New York.

PIGEONS—The finest Pigeon Magazine, $1.00 a year, or send 25c. for four months' trial. Pigeons Magazine, 948 Advertising Bldg., Chicago.

MODERN Dances—Best Instruction Book for beginners. 17 dances fully illustrated. 25c. prepaid. Danse Publishing Co., 500 Fifth Ave., New York.

HAVE YOU SEEN A COPY?—Amateur Photographer's Weekly, $1 per year; weekly prize competitions; criticisms; print exchange; illustrated; many features. Three months' subscription 25c. Amateur Photographer's Weekly, 915 Schofield Bldg., Cleveland, Ohio.

ENGINEERS' questions and answers for license by Hobson for 25c. postpaid. Send stamps. Reilly's Book Store, Dept. E., Philadelphia, Pa.

PERSONAL—War Pictures and Catalogue. 10c. Paul Cornish, Schenectady, N. Y.

BICYCLES AND MOTORCYCLES

CLOSING Out Sale high-grade slightly used motorcycles. We have about 50 left to sell, in standard makes which we are offering at big bargains, such as twin and single-cylinder Indians, Yales, Harley-Davidsons, Merkels, Thors, Excelsiors, Popes, 4-cylinder Hendersons and Pierces. These motorcycles we want to close out this year. No reasonable offer will be refused. Write to-day for our list giving description and prices. Gotham Sporting Goods Co., 57 Warren St., New York City.

FOR Sale cheap. 1914 Harley-Davidson twin. Write for particulars. Walter Goerke, 321 Washington St., Newark, N. J.

1908 H. D. SINGLE with clutch and magneto, $30. 1910 H. D. battery model. A-1 condition, $35. 1911 H. D. single magneto model and clutch, $40. 1910 H. D. clutch and magneto, $45. 1 Indian motorcycle motor with magneto and Schebler carburetor, $25. 1 Excelsior motorcycle motor, $25. C. H. Lang, 1704 Michigan Ave., Chicago, Ill.

$50 TO $150 buys the best Motorcycles, every make and model in our large stock—must be cleared. Half price. Send for list to-day. Talking Machines, $5 and up. Brown Music Co., 9119 Commercial Ave., Chicago, Ill.

SEND for latest Bulletin of real Motorcycle Bargains, used and slightly used, all makes, models and prices; if you have $25 and really want a powerful Motorcycle, send for this Bulletin; hundreds of machines at all prices, new ones on easy payments; tell us what you want and how much you can pay; we can fix you up. Peerless Motorcycle Co., Dorchester, Mass.

USED Motorcycles, all makes, bargains. Send for list. Ward Bros., 212 Broadway, Camden, N. J.

OUR folder showing the new '15 Eagle 2-speed models is ready for mailing. Write for this and for the agency to-day. Sterling Motor Co., Brockton, Mass.

RIDERS: Write for our catalogue of motorcycle accessories and supplies. Andrews Specialty Co., 55 Warner St., Rochester, N. Y.

5-HORSE Pierce, single cylinder, magneto, Schebler carburetor, new tires, perfect running order, $125.00. Fred Gile, 50 Forest Ave., Portland, Maine

GET copy of "Motor Cycle" published in England. Special War Issues received here weekly. Price 15c. Two for 25c. Distributors, 143 So. Wabasha, St. Paul, Minn.

FORMULAS

LATEST FAD. The celebrated everlasting fragrant rose beads can be easily made and sold with big profit. Strings sell as high as $3.50 to $5.00. Formula with full instructions for making same, 25 cents coin. J. C. Regan, 1162 Broadway, New York.

IS the formula you want worth a quarter? State exact requirements. Raymond, Roosevelt, N. Y.

1,000 TRADE secrets and formulas, 25c. 500 selected formulas, 20c. Resilver mirrors, guaranteed process, 20c. Make Sneezing Powder and Itch Powder, 10c. each. Entire lot, 50c. Service Bureau, 3111-T, Belleplaine Ave., Chicago.

MAKE Candy evenings; pays; receipt, 10c. Elmer Zimmerman, 1435 Walnut, Harrisburg, Pa.

START factory making candies, gums, crackerjack, orangeade, ciders, etc. Sells fast. Nearly all profit. $15 course $1.00. Catalog, 2c. Robert Hamilton, Barnes City, La.

SIX Valuable formulas for sympathetic inks, 50c. Wayne Thomas, Ithaca, N. Y.

FORMULAS for inks, black, blue, red, gold, green, silver, indelible, 15c each. 7 for $1.00. Stephen Rafferty, 2122 Arch St., Philadelphia, Pa.

CUTS anybody can make, 5c. Samples Stamp. Modern Engraving Co., Lynn, Mass.

AGENTS—Build a business of your own with our Piano and Furniture Polish. Have used it in our shop successfully for five years. Send $1.00 for formula and trade secret. E. E. Lundberg School Piano Tuning, 143 N. Dearborn St., Chicago.

PHOTOGRAPHIC

WE buy, sell and exchange. Bargains in Microscopes, Telescopes, Binoculars, Cameras, etc. Bargain list sent. Kahn & Son, Opticians, No. 54 John St., New York. Established 62 years.

SPOT Cash paid for high-grade Kodaks, Lenses and Cameras. Send full description, stating lowest price. Cameras exchanged. In business since 1885. David Stern Co., Dept. M, 1047 W. Madison St., Chicago.

FILMS developed, 10c., all sizes. Prints 2¼x3¼, 3c.; 2½x4¼, 3½x3½, 3¼x4¼, 4c.; Post Cards, 50c doz. Work guaranteed and returned 24 hours after receiving. Postpaid. Send negatives for samples. Girard's Commercial Photo Shop, Holyoke, Mass.

ROLL Films developed 10c. per roll. Printing Post Cards, 3c. each. 15 years' experience. Give me a trial. You will be pleased. F. C. Hoyt, Sac City, Ia.

EXPERT Kodak Finishing! Send for price list. Electric Studio, 162 Stephenson St., Freeport, Ill.

KODAK films developed. 5c., all sizes. Prints, 3c. each, any size. P. Johnson, 100 W. Bridge St., Oswego, N. Y.

TRANSFER pictures to china, etc.; no formulas; particulars. Flinn, 286 West 142nd St., New York City.

THINK OF IT! Only $20 for finest German Double Anastigmat in Ibso shutter, for 3A Kodaks and postal card cameras. Send for matter describing best Lenses on earth at way down prices. Lafbury Co., 305 North Fifth Ave., Chicago.

FILMS developed 10c., all sizes, prints 2¼x3¼, 3c.; 2½x4¼, 3½x3½, 3¼x4¼, 4c.; Post Cards, 50c. dozen. Work guaranteed and returned 24 hours after receiving. Postpaid. Send negatives for samples. Girard's Commercial Photo Shop, Holyoke, Mass.

$54 CENTURY Grand, bargain, $25. Magnificent Ensign Reflex, Zeiss Triotar Anastigmat, complete, $65. $22.50 Autographic Kodaks, $19.75. Slipin Calender Mounts, assortment, $1. Catalognes mailed. Newark Photo Supply Co., Newark, New Jersey.

HEADQUARTERS for selling or exchanging Cameras of all kinds. Carry a full line latest Kodaks. Graflex. Premos, foreign Cameras. Write for big bargain list. Gloeckner & Newby Co., 171 Broadway, New York.

KODAK Films Developed, 10c. per roll, any size. Prompt attention given mail orders. Prints, 2¼x3¼ to 3¼x4¼, 3c.; 4x5 to 3¼x5½, 4c. J. M. Manning, Box B, 1062 Third Ave., New York City.

MOVING Picture Camera. No larger than a kodak, uses standard film. Catalogue free. Goff, 3440 Michigan Ave., Chicago.

PRINTING

POSTPAID—1,000 envelope slips, 75c.; 500 two-color bond letterheads, or envelopes, $1.00. Samples free. The Ryder Print Shop, Dept. M6, Barnerville, N. Y.

PREPAID, Printing (600 miles) 1,000 bond letter heads, $2.39; envelopes, $2.14; return envelopes, $1.77; imitation typewritten letters, 150 words, $1.73; 300 words, $2.64; 6x9 circulars, $1.75; art ad slips, $1.00. Ask for prepaid prices on any printing. Good's Quick Print, Harrisonburg, Va.

MAGIC AND TRICKS

MAGIC pocket trick free. Worth 25c. With illustrated catalog of 250 tricks, puzzles, illusions, for 6c. Stamps. Magic Co., Sta. 10, 249 West 38th St., New York.

POST Cards, Tricks and Jokes, Coins, Notes, Stamps and curious things. Catalog for stamp. Coin Exchange, New Rochelle, N. Y.

BIG Catalogue. Magic, Entertainment goods free. Bates Co., Melrose, Mass.

MAGIC Tricks, Jokes and Puzzles. Trick with my catalogue, 10c. coin. H. V. Dils, Huntington, W. Va.

GREAT book wonders, secrets and mysteries and novelty catalogues, 10c. Wright Spec. Co. (D), Brewster, N. Y.

MAGIC tricks for the profession. Big catalogue and pocket trick free. Ventriloquial figures, $6.00 up. Magic Parlors, 192 Clifford, Providence, R. I.

NOVELTIES, Books, Tricks, Games, Etc. Illustrated catalogue free. Sample 25c. card trick, 10c. Auburn Supply Co., Specialty Dept., 7745 Peoria St., Chicago.

SECRO-WRITO; New System of secret writing. Keeps your correspondence safe and private. Strangers cannot read your cards and letters. Great fun for everybody. Samples and instructions, 10c. H. J. Teeple, Decatur, Indiana.

GREENBACKS—Yellowbacks, Stage money. New kind, 10c. bunch; 4—25c. Eureka Supply, P29, 3827 N. Kenneth, Chicago.

250 MAGIC Tricks with cards, coins, etc., 10c. Greenbacks, big wad, 10c. Novelty Shop, 3311-T, Belleplaine Ave., Chicago.

GIVE 'em the "creeps" with the Mysterious Skull. Shines, without any light, in the dark. Really wonderful, 10c. Bartlett, Box 960, Milwaukee.

MODELS

MODELS made for inventors; general machine work; designing and perfecting; developing automatic devices and machinery; in a position to do all kinds of light tool and machine work. Prices reasonable; estimates cheerfully given. Ideal Machine Works, 62 Ann Street, New York City.

INVENTORS: We manufacture metal articles of all kinds to order. Also special machinery, tools and dies; punchings, lathe and screw machine work, metal spinnings, castings, plating, wood and metal patterns, etc. Send sample for estimate and expert advice, free. The Eagle Mfg. Co., Dept. B, Cincinnati, Ohio.

SMALL Gasoline and Steam Engines and Castings. Experimental apparatus. Toys. Big catalogue for 10c. Amateur Mechanics Co., First National Bank Building Chicago.

PRODUCERS of Results; Inventions Developed, Light Mfg., Models, Experimental Work, Tools, Dies and Stampings. Johns Machine & Stamping Works, Middle Bldg., Dept. C, Cleveland, Ohio.

MODELS, dies and manufacturing for inventors, by builders of "Tools That Work." La Croix Tool Co., 214 N. 21st St., St. Louis, Mo.

MISCELLANEOUS

ENGINE Lathe, swings 9½ in., takes 25 in. between centers. Complete set gears cutting all size threads 3 in. to 40 in., $43.50. Grammes & Sons, Allentown, Pa.

MANSFIELD'S Electrical Water Finder is a thoroughly reliable appliance for locating positions for sinking wells for pure water supplies. Send for particulars to Mansfield & Co., Engineers, New Brighton, England.

THE FRITZ NOVEL INSULATOR for sale, outright or royalty. Osville J. Fritz, Weisenburg, Pa.

WATCH and Phonograph for sale cheap. Box 424, Waubay, S. Dak.

PATENTS without advance attorney's fees. Not due until patent allowed. Send sketch for free report. Books free. Frank Fuller, Washington, D. C.

STAMPS AND COINS

STAMP Album with 538 Genuine Stamps, incl. Rhodesia, Congo (tiger), China (dragon), Tasmania (landscape), Jamaica (waterfalls), etc., 10c. 100 diff. Jap., N. Zld. etc., 5c. Big list; coupons, etc. Free. We buy stamps. Hussman Stamp Co., St. Louis, Mo.

GET the most out of your money you can. Try my 1, 2 and 3-cent approvals and you'll be pleased. References required. Wm. Haase, 971 E. 39th St., Los Angeles, Cal.

STAMPS, 100, ALL DIFFERENT, FREE—Postage 2c. Mention paper. Quaker Stamp Co., Toledo, Ohio.

FOREIGN Stamps Free, 52 different foreign, including China and Venezuela, to all who apply for our high grade approval selections. Send two cent stamp for return postage. Edgewood Stamp Co., Dept. H, Milford, Conn.

$4.25 EACH paid for U. S. Flying Eagle Cents dated 1856. Hundreds of other U. S. and Foreign Coins wanted. Send 10c. at once for New Illustrated Coin Value Book 4x7. It may mean your good fortune. Clarke Coin Co., Box 94, Le Roy, N. Y.

MAIL ORDER OPPORTUNITIES

EVERYTHING in the mail order line; state your wants and we will do the rest. Pacific Specialties Co., Los Angeles, Cal.

EUROPEAN War Map and chances to start a profitable business of your own, 10c. C. S. Mathews, 69 East 87th St., Portland, Ore.

WE will start you in the cleaning and dyeing business. Little capital needed. Big profits. Write for booklet. Ben Vonde System, Dept. A-K, Charlotte, N. C.

MAIL Order Men. Would you like to know how 61 successful mail order men do business? Especially if these men tell you their own experience in their own words. The Mail Order Business Builder gives you such information direct from these men's private offices from month to month. Send dime for sample copy of this 64-page magazine. Randolph Rose, Publisher, No. 8 Broad St., Chattanooga, Tenn.

WIRELESS

FREE—A beautiful Wireless Receiving Set enabling you to receive messages 300 miles, for selling only 25 boxes of my Spot Remover. Sells on sight. Be one of the first in your town to own a Wireless Set. Write now. Marge Co., 702 N. 6th St., East St. Louis, Ill. Dept. K.

$10.00 COMMERCIAL KEYS for $4.00. Massie Wireless Telegraph Co., Providence, R. I.

"WIRELESS CHART" giving capacity, wave length, inductance, etc., values directly. Why wade through complicated formulas? "Chart," prepaid, 20 cents. Send stamp for list of labor saving charts. H. Secor, Consulting Engineer, 2040 7th Ave., New York City.

INCREASE your radiating efficiency. Use an Oscillation Transformer. Price $6.50. F. C. Thiede, 486 Decatur St., Brooklyn, N. Y.

DOUBLE Slide Tuners, $1.75. Extra sensitive Detectors, $1.00. Head Receivers, 1,000 Ohm Phones, aluminum Headband, $5.50 complete. Write for prices on all your wireless needs. Wm. Paul, 134 Dewey Ave., Jamaica, L. I.

BEFORE you try to wind secondaries for a coil or transformer get our prices, we can save you trouble and money. State your wants plainly. Eureka Secondary Co., 6939 S. May St., Chicago, Ill.

Scientific Exchange Columns

UNDOUBTEDLY you have at the present time some things for which you have no further use. Do you wish to sell these things or exchange them for something, for which you have immediate use? There is no surer and quicker way to do this than by advertising your articles in these columns. The **Very** people, the **Only** people, who could possibly have a use for your things read this journal. More than 30,000 interested people will see your ad. It is furthermore the cheapest advertising medium for you in the country.

The rates are: One cent per word (name and address to be counted) minimum space 3 lines. Count about 7 words to the line. **Remittance must accompany all orders.**

We reserve to ourselves the right to refuse any advertisement which we consider misleading or objectionable. Advertisements for the July issue should reach us not later than June 10th.

The Classified Columns of "The Electrical Experimenter" Bring Positive Results.

WILL EXCHANGE a 6 volt 80 ampere Willard Storage Battery for 8 volt 10 ampere dynamo, or other dynamo of similiar capacity, or phonograph of good make, or what have you. Samuel Cohen, 1936 Pitkin Ave., Brooklyn, N. Y.

STORAGE BATTERY—6/60. Sheldon School text books Powell Adv. Course. Want Electric Enlarging Lantern or good Camera. Baker, 3440 Michigan Ave., Chicago.

EXCHANGE—8x10 View Camera and large finishing outfit, fine condition, like new, cost $70.00; also one single shotgun. Want motorcycle, sporting goods, electrical goods, smaller camera or what have you. Also have a Waltham 15 jewel watch, 20 year case. Anton Rank, Buffalo Center, Iowa.

FOR SALE—New Murdock small variable for $2.00; Miller loose coupler a bargain for $1.75; or will exchange both for Murdock antenna series condenser. Write for picture. G. W. Spaulding, Osakis, Minn.

WILL EXCHANGE for motorcycle, complete wireless sending and receiving outfit, ½ K.W. transformer, Standard motor, rotary spark gap, large helix, glass plate condenser, 2,000 ohm. phones, loose coupler, loading coil, combination detector and condenser. W. R. Miller, 357 45th St., Pittsburgh, Pa.

TYPEWRITER BARGAIN—$6.00 for genuine Chicago machine, 90 characters, steel letters. These machines now being sold by the manufacturers for $35.00. This machine is practically new. Perfect condition guaranteed. Money back if not satisfactory. Also very fine triple magnet A. C. generator, $2.00, perfect condition; the magnets alone are worth the price. Hulet Mfg. Co., W. Point Pleasant, N. J.

EXCHANGE a spark gap motor A. C. or D. C. 1,500 ohm pair phones, value $12.00; want Belgian hares or watch dog. H. C. Boyer, McKees Rocks, Pa.

3,000 OHM Government phones, E. I. Co., Loose Coupler and Sending Helix, all for $5.00. Harold B. Adams, 3100 Broadway, New York City.

WILL EXCHANGE—Professional Loose Coupler, Variable Condenser, and Potentiometer (all Electro make), for Audion or Typewriter. Alfred Theis, 512 East 88th St., New York City.

HAVE Battery Motor that I will sell for 50c. Also a North Pole Alarm Clock, absolutely new, for 75c. Postage extra. H. C. Gerlach, 419 W. 119th St., New York.

WILL EXCHANGE complete I. C. S. electrical engineering library or good disc talking machine or both for small gasoline engine. E. G. Clark, Shelby, Ohio.

WILL EXCHANGE—A $4.80 Omnigraph, good as new, and a $3.75 17-Plate Electro Variable Condenser for a good Loose Coupler. Must not be home made. Delbert Myers, Box 4, Amboy, Ind.

FOR SALE OR EXCHANGE—Two cylinder, four Cycle Engine or partly finished 9 in. Lathe Castings for Audion Set. For details address Morse Lloyd, Portsmouth, O.

FOR SALE OR EXCHANGE—Electrolytic Detector and Potentiometer, together or separately. Would like to exchange pictures of wireless stations with amateurs. Donald Rockwell, Wellsboro, Pa.

TO EXCHANGE—Tandem Bicycle without tires, good coaster brake. What have you electrical? Dynamo, generator or electric fan. Charles Train, 11 Hanson Ave., Somerville, Mass.

FOR SALE—Electro Static Machine. Perfect condition, like a new machine. Postal order for $2.25 takes it. E. P. Chamberlain, Brownfield, Me.

TO EXCHANGE—Peroxide of lead Detector, Potentiometer, 1½ pint Leyden Jar, Splitdorf Spark Coil, Sounder, Battery Motor, single slide Tuner, 12 gauge Shot Gun. Carlton S. Fernyak, Mansfield, O.

WILL SELL—Two in. E. I. Co. Spark Coil, Loose Coupler, tunes 3,000 meters; Mandelett Camera; these articles are all nearly new. Burns Hempstead, Croton, O.

FOR SALE OR TRADE—One E. I. Co. "Interstate" Receiving Outfit, $3.00. Ideal for beginners, in excellent condition, will trade for Variable Condenser, Spark Coil or offers. Gartz Windenburgh, Lamont, Ia.

WILL EXCHANGE—500 shares Los Angeles Building Company for complete Sending Outfit, High Power. Joe Sykes, Los Angeles, Cal.

BARGAIN—One set Applied Electricity, one set Engineering, one set Auto Engineering. Perfect condition. Also step-down Transformer, pair Duplex Phones, Detector on genuine rubber base, Water Motor. Generator 20 V. 5 Amp. Details for stamp. J. A. Wever, 233 S. Patterson Park Ave., Baltimore, Md.

FOR SALE—Five-Ohm Telegraph Instrument, $1.00; double leather covered Headband, 80c.; Omnigraph No. 3777, $1.50; "Electro" Loading Coil, $2.20; Loose Coupler Receiving Outfit, $4.25; Hand Printing Press, lots of type, $4.00. All in good condition. Owen Cook, Marinette, Wis.

WILL SELL—Twelve-inch High Frequency Coil, direct or alternating current; six-inch X-Ray Tube for same; 5x5 Fluorescent Screen. All as new. Reasonable. Irvine, Box 325, Bay Shore, N. Y.

HAVE Violin, Camera and Outfit, Telescope, 1,000-ohm Single Headset, ¼-inch Spark Coil, Loading Coil and lot of other chemical, wireless and electrical apparatus, also large variety of books. Send for complete list. Will sell cheap or exchange for double headset, loose coupler, spark coil or what have you? O. Vandt, 118 Crane St., Schenectady, N. Y.

FOR EXCHANGE—Phonograph (Cabinet) and nine Double Records; cost $25.00; Rifle, cost $7.50, for wireless goods and static machine and apparatus or offers. Bernard Merrick, Conneaut, O.

WOULD like to buy an Omnigraph in good condition. Please write Joseph Klauser, 388½ Pulaski St., Brooklyn, N. Y.

SHEET Fibre, ½ in. thick, $1.50 sq. ft.; ¾ in., $2.25 sq. ft.; 1 in. thick, $3.00 foot. Will sell ½ sq. ft. or over. George Blum, 817 West End Ave., New York.

WILL SELL cheap. Bunnell battery rheostat, 40c., also small rubber switchboard, $3.00; no instruments. Jos. Lowenstein, 255 W. 112th St., New York.

THE NEW
MURDOCK SPECIAL No. 55
WIRELESS RECEIVERS



With Regular Head Band

Complete 2000 Ohm Double Head Set

ONLY

$4.00



With Coronet Head Band $4.50

Absolutely high grade real wireless receivers, equal in sensitiveness, quality of materials, and dependability to any obtainable anywhere at many times the price.

We will, upon receipt of price, deliver a Murdock Special set, with the privilege of fourteen days trial. If for any reason the purchaser is dissatisfied, either with the receivers or our claims, the purchase price will be immediately refunded upon return of receivers.

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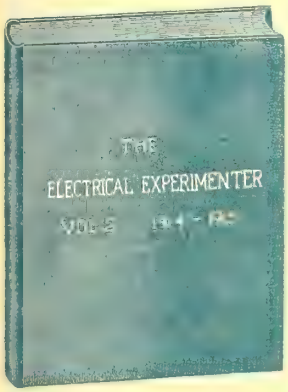
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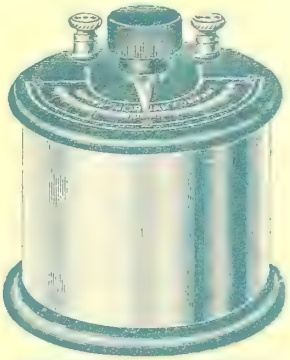
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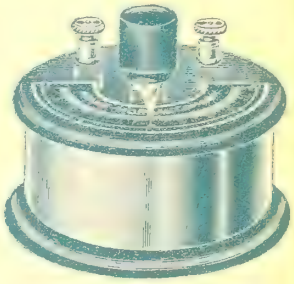
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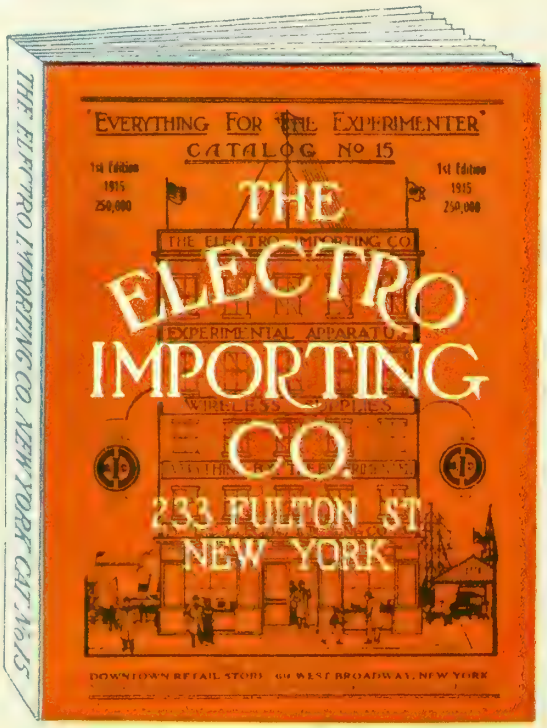
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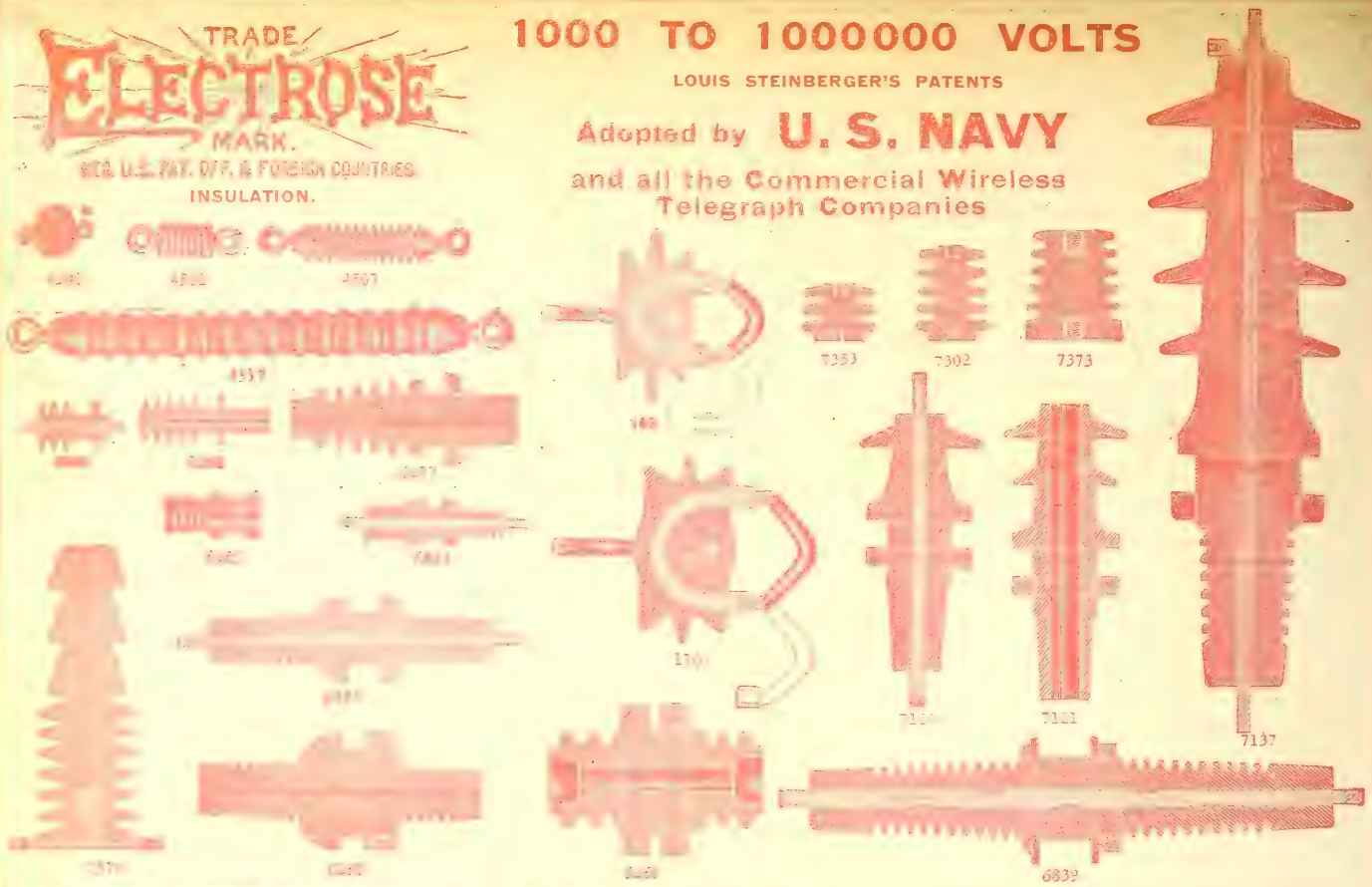


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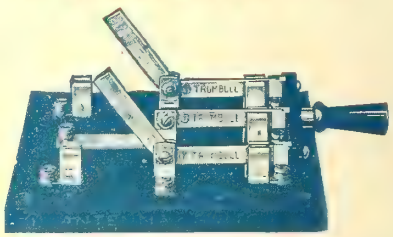
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Vol. III Whole No. 27 CONTENTS FOR JULY, 1915 No. 3

LIBRARY MAR 14 1929 U. S. PATENT OFFICE

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COVER DESIGN...From a Painting by Thos. N. Wrenn —
EDISON PERFECTS THE TELESCRIBE..... 83
A DAY WITH WILLIAM J. HAMMER.....By Samuel Cohen 84-85
NEW INVENTIONS IN PHOTO PLAYS..... 86
UNCLE SAM'S BATTLESHIPS AT NIGHT..... 87
ELECTRO-PLATING WITH COBALT..... 87
BARON MÜNCHHAUSEN'S NEW SCIENTIFIC ADVENTURES.....By Hugo Gernsback 88-89
ELECTRICITY HELPS TO HEAL GERMAN SOLDIERS' WOUNDS..... 91
ELECTRIC BULB COMPOSED OF 16,000 LAMPS. 91
PLAYING CHECKERS BY TELEGRAPH..... 92
STUDY OF FLOWERS WITH THE AID OF X-RAYS..... 92
LUMBERING TELEPHONE SIGNAL SERVICE...By Frank C. Perkins 93
ELECTRICAL NOVELTIES FOR THE BANQUET TABLE.....By Felix J. Koch 93
A PHONOGRAPH-TELEPHONIC LECTURER..... 94
LOCATING BURIED PIPES ELECTRICALLY..... 95
THE MACROPHONE OR LOUD-SPEAKING TELEPHONE..... 95
AN ELECTRICAL INSPECTOSCOPE..... 95
POWERFUL MAGNET DRAWS STEEL FROM BODY..... 96
AMERICA'S VICE-PRESIDENT TRIES ELECTRIQUETTE.....By Felix J. Koch 96
A MINIATURE HIGH FREQUENCY SET THAT FITS THE HAND..... 97
ELECTRICAL ILLUMINATION OF THE STOMACH..... 97
NEW LAMP SIGNALS ON PENNSYLVANIA RAILROAD..... 98
"THE CONSTRUCTOR" DEPARTMENT..... 99
WRINKLES, RECIPES AND FORMULAS.....Edited by S. Gernsback 102
BOOK REVIEW..... 102
ELECTRICITY, THE POWER BEHIND THE SUBMARINE BOAT.....By H. Winfield Secor 104-105
"WIRELESS DEPARTMENT"..... 106
"HOW TO MAKE IT" DEPARTMENT..... 111
ELECTRICAL MAGAZINE REVIEW..... 114
LATEST PATENT DIGEST..... 115
"AMONG THE AMATEURS"..... 116
"PHONEY" PATENTS..... 117
"QUESTION AND ANSWER" DEPARTMENT..... 118
PATENT ADVICE..... 121

"The Obsolete Submarine"

IN analyzing past and present means of warfare, we invariably find that it is possible to combat weapon by weapon. Thus the early cliff dweller could combat his club-swinging adversary by means of a club; the one swinging the club most adroitly won. You can combat the lance with a lance; a sword with a sword; gun against gun; one cannon can fight another with a cannon; one battleship can attack and combat successfully another battleship. But—and here we have a singular exception, the paradox of the present war—you cannot fight one submarine with another submarine. Nay, you cannot properly combat—as that term is understood—the submarine with any present means. For we cannot fight what we cannot see; to-day, as in the past, the most dangerous enemy is the unseen one.

The modern submarine is dangerous only because of its invisibility. If we find a means to make it "visible" the submarine will become obsolete. When this moment arrives the battleship will come into its own again, as well it may.

The present submersible is made possible only due to the use of electricity; it could not exist without that agency. Our imagination need not be stretched unduly to presume that electricity will, in the not too distant future, be employed to render the submarine harmless. Indeed, scores of our greatest scientists all over the world are working along these lines, our own FESSENDEN having already obtained certain results which seem exceedingly promising.

Speaking generally, a ship is safe in a harbor; it is endangered only in the open sea. If the captain has accurate knowledge of the whereabouts of the submarine and if he runs away from it at full speed his ship, as a rule, cannot be overhauled by the relatively slow undersea craft. The obvious problem then is to locate the submarine when it is as yet from three to five miles distant. It is, of course, necessary also to know in what direction the submarine is located, because it may make for the ship, running submersed, without showing its periscope.

How can we locate it then? The problem does not present unsurmountable difficulties. Several means may be used. We can imagine a very refined magnetic indicating detector mounted below water on each side of the ship. If this detector is sufficiently sensitive to large iron or steel masses (it could be shielded against its own ship) it would become a simple matter of locating the submarine or even a mine. For it must not be forgotten that a submarine of necessity sends out a considerable magnetic flux.

Another means to detect submarines lies in the use of some form of etheric waves. We can imagine an apparatus, say at the bow of the ship, sending out waves below the water while a suitable detector at the stern, also below water, is used to register the "echo" and its intensity. The original waves striking the submarine will be reflected and bent back. The intensity of these reflected waves could be made to read off on a direct recording scale, giving the distance of the submarine in miles. Recent researches show the possibility of sending etheric waves below water, so we may be sure that the interesting problem of locating submarines will not remain unsolved for any great length of time.

The above presents such a rich field of opportunities for the investigator that it seems worth while to bend all our energies toward its successful solution. Humanity will breathe easier when the now treacherous submarine can be successfully combated.

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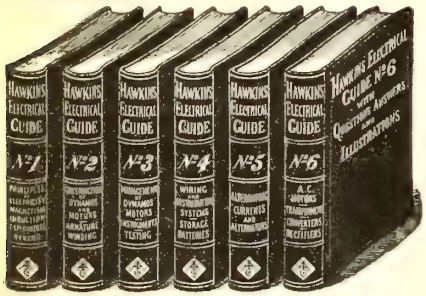
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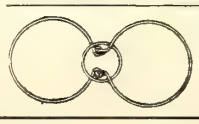
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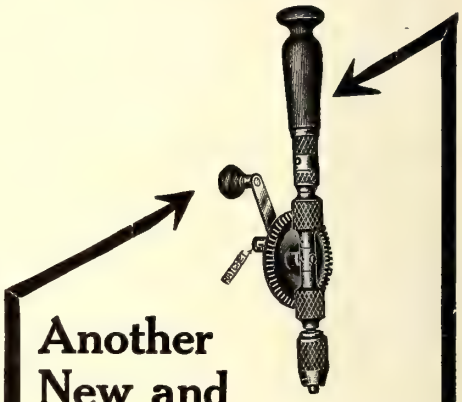
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Vol. III. Whole No. 27 JULY, 1915 Number 3

Edison Perfects the "Telescribe"

THOMAS A. EDISON, at sixty-eight, announces the perfection of the telescribe, a combination of telephone and phonograph, by which the telephonic conversation of persons 3,000 miles apart can be perfectly recorded on a wax record. Its completion gives Mr. Edison the credit for more than 1,500 inventions and more patents than ever have been issued to any other individual.

With the telescribe, "canned evidence" of a litigant's own words in his own voice may be heard by a jury.

The telescribe consists of a sensitive telephone for desk use with controlling buttons to operate a recording machine nearby. It is so sensitive and so adjusted that the slightest vibration is recorded.

When he invented the carbon telephone transmitter and the phonograph, thirty-eight years ago, Mr. Edison conceived the idea of the telescribe. More than a generation of invention and scientific development is centered in the new apparatus, which Mr. Edison says "the world will soon recognize as a great commercial asset. It makes the telephone more useful, the phonograph more valuable and both more necessary."

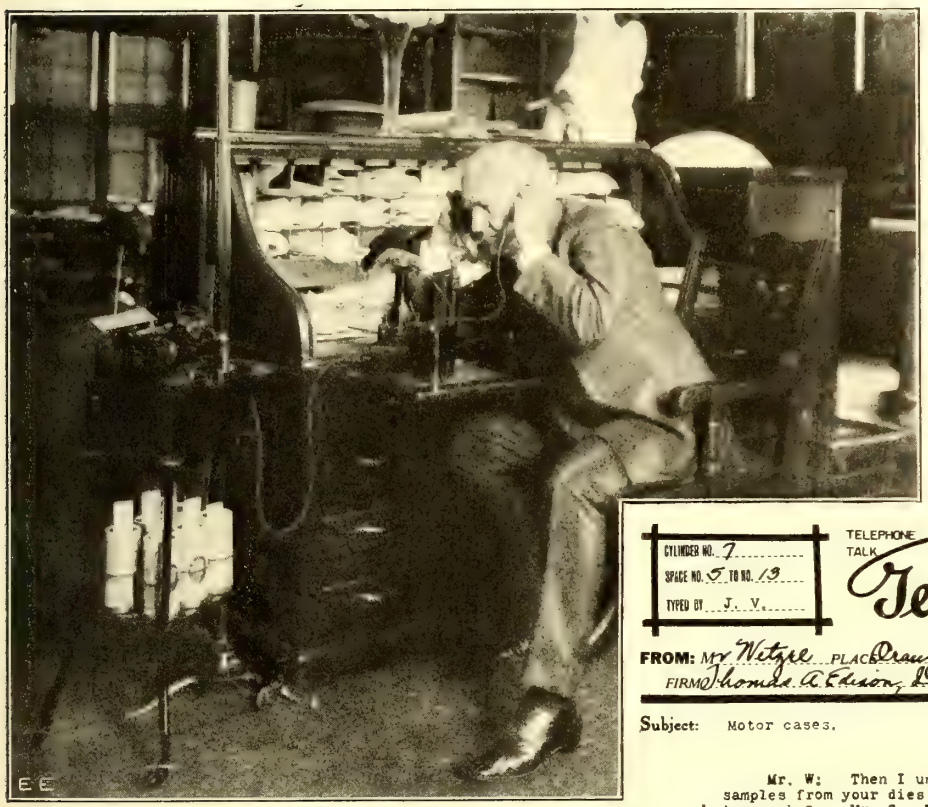
Had there been a telescribe at either end of the transcontinental wire between the White House and the Panama-Pacific Exposition when President Wilson spoke the words that opened the fair, his sentences might have been recorded and perpetuated for posterity.

After the words of the telephoning persons are recorded on the wax record if important enough, it may be preserved, or it may be used 100 times if the intelligence on it is taken by a typist and the record "shaved." What is known as a "telescript," a patented form somewhat similar to a telegram and here shown, is signed and mailed to one of the parties that has talked, should he desire an exact copy of the entire conversation. In case of a long distance telephone call, which involves considerable expense, in the absence of the person desired, one in the office need only to press a button and the person at the other end may speak what he has to say into the phonograph to be listened to later by the person for whom it was intended.

More than a generation of invention and development is centered in the telescribe.

The two arts—telephonic and phonographic—which it combines, have been closely associated in Edison's mind from the earliest development. His experience with diaphragm action in the carbon transmitter in 1876 led immediately to the invention of the phonograph in 1877, and we find his early prophecy of the telescribe in these words:

(*Continued on page* 85.)



At Left: Mr. Edison Using His Newly Perfected "Telescribe."

CYLINDER NO. 7
SPACE NO. 5 TO NO. 13
TYPED BY J. V.

TELEPHONE TALK RECORDED ON THE TELESCRIBE

Telescript

DATE 4/13 1914
HOUR 10 MIN. 35 am
SPEAKING 2 MIN.

FROM: Mr Wetzel PLACE Orange TO: Mr. Grey PLACE E Orange NJ
FIRM Thomas A. Edison, Inc. FIRM C. M. Grey M'f'g Co.

Subject: Motor cases.

Mr. W: Then I understand, Mr. Grey, if we approve the samples from your dies today, we can expect deliveries within two weeks? Mr. G: That's sure, if I can get your order for at least five thousand (5,000). Mr. W: The order for 5,000 goes tonight with the approved samples, but I've got to know we will get the first cases by April 15th, delivered 500 a week after that. Mr. G: You get me the approved samples with the order, and I'll do my part. Mr. W: Say, Grey, I want you to note the change we made in the top lugs----we've made them a little heavier. Don't forget to change your dies before you commence the run. Mr. G: That will be all right.

Approved C. J. Wetzel
Production Mgr.

Above: A Specimen "Telescript" or Record Made on the Edison Telephone Message Recorder. It Works Automatically and Saves a Lot of Time in Handling Everyday Business.

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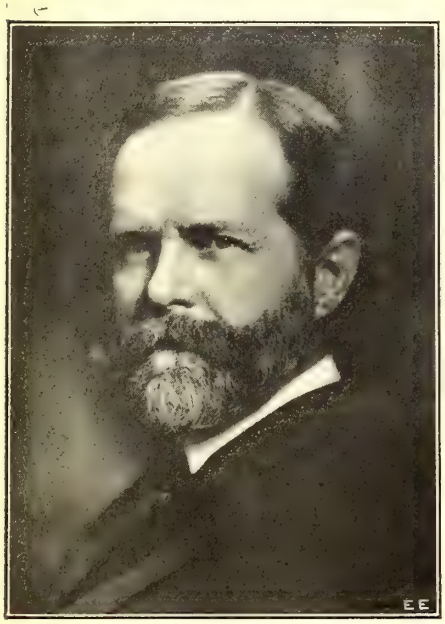
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A Day With William J. Hammer

By Samuel Cohen

IT was a mid-week day, not long ago, when I took advantage of the invitation extended by William J. Hammer to visit him in his laboratory in New York City.

First and foremost, Mr. Hammer is a consulting electrical engineer, and was one of Edison's earliest assistants at his Menlo



Mr. William J. Hammer the Well-Known Consulting Engineer of New York City.

Park laboratory during the development of the incandescent lamp, telephone, phonograph, electric railway, etc. This gentleman was one of the real pioneers of the incandescent electric lamp and in the development of the transmission of electrical power, both here and abroad, having been chief engineer of the English Edison Co. in 1881-2, also chief engineer of the German Edison Co., known as the Allegemeine Elektricitaets Gesellschaft, in 1883-4.

In 1883 Mr. Hammer invented and constructed the first motor-driven electric "flasher" sign, now universally employed. This sign, which flashed the name "Edison," letter by letter and as a whole, by means of a commutator or "flasher" driven by an electric motor, was placed on top of the Edison Pavilion at the International Health Exposition in Berlin, Germany; also a simpler form was constructed to be operated by hand as early as 1881, and it was used for a year at the Crystal Palace Exposition in London.

After we had had an interesting chat this great man conducted me to his marvelous laboratory, which is seen in Fig. 1. It is in this laboratory where the most wonderful experiments and discoveries imaginable in phosphorescent substances, X-rays, ultra-violet rays, radium phenomena, selenium, etc., have been conducted.

This savant is one of the leading authorities on selenium in this country and has compiled a remarkable bibliography upon the subject. Many different types of selenium cells have been devised for various purposes. Some of these he has invented and patented, and has also perfected automatic devices for starting motors, controlling gas and electric street lights, for opening iron window shutters in the morning and closing them in the evening, automatically firing cannon, the prevention of boiler explosions, protecting safes, etc. This untiring worker has also developed, to some extent, a system of "seeing over a wire" and has patented a selenium photometer. All these devices are operated with selenium cells. Various experiments have been carried on in radio-telephony by the use of selenium cells, and wireless has been employed for domestic purposes in his house, for calling servants, ringing bells, etc. He was for a time associated with the late Prof. Ernest Ruhmer, of Berlin, Germany, who is well known for his experiments in radio-telephony and selenium-cell work, as well as for numerous technical publications.

To resume: In a few minutes the laboratory became dark and the wizard performed for me several extremely interesting experiments. For instance, I was told to watch a large bouquet of artificial flowers, which appeared in their natural color. A Weintraub-Steinmetz mercury arc lamp was now lighted and kept in operation for a few moments. The lamp was then extinguished by opening a switch. The room was dark as pitch, but the flowers, roses, tulips and lilies, which could not be seen at all a minute before, now *glowed beautifully* with many different colors. Further demonstrations included numerous bottles containing chemical and mineral substances, which by exposure to the mercury lamp also radiated glowing rays, and each bottle had a different color. Figures, letters, statuettes, even model aeroplanes and balloons, etc., around the room, all became brilliant. It was explained that all these objects were coated with some special phosphorescent substances and, when stimulated by the mercury lamp rays, they will give off considerable light for a long time. The phosphorescent mixtures used on watch and clock dials and containing radium salts were originated in this laboratory. After years of study it was discovered how to combine phosphorescent and fluorescent substances so as to produce practically any brilliant color in the dark when the substances are stimulated by the mercury arc lamp or ultra-violet light, sunlight, etc. A basic patent upon this discovery has been allowed.

Mr. Hammer has spent an unbelievable amount of study on the phenomena which occur inside and outside of different types of vacuum tubes. Note the many shapes and kinds of tubes seen on the shelves of his laboratory. Another ingenious device I saw was a machine driven by electric motors, by means of which can be illustrated, mechanically, upward of 100 different forms of physical phenomena.

No less than 34 long years were expended in systematically collecting various kinds of electric lamps in this country and in Europe. This was done for the purpose of showing the complete steps in the development of the incandescent electric lamp, from the earliest work of Edison, Swan and others to the latest nitrogen-tungsten lamp. Five large glass cases, four of them 10 feet long, contain the collection, which is exhibited in the rooms of the American Institute of Electrical Engineers, 25 West Thirty-ninth street, New York City. One of these cases is shown in the photograph Fig. 2. The collection contains more than 1,000 different lamps, and this collection which Mr. Hammer has termed the "history of an art," represents the only art in the world of which such a record has been made. It is thoroughly complete and without a single important missing link.

The radiant efficiency of the original carbon-filament incandescent lamp was about .43 of 1 per cent.; that of the tungsten lamp about 5 per cent., and that of the new nitrogen-tungsten lamp is about 10 per cent. On the other hand, the light of the fire-fly and the "pyrophorus noctilucus" or, as commonly called, the *Brazilian beetle*, have an efficiency of 96.5 per cent. as shown by measurements made by Professors Langley and Very with the bolometer,



Fig. 1. The Marvelous "Hammer" Electrical Laboratory, Where Every Conceivable Interesting Scientific Instrument is to be Found.

and also by Coblentz with the thermopile. This investigator believes that "cold light" is the real light of the future. Already photographs have been taken by the light of fire-flies and other forms of "cold light" in his laboratory.

Photograph 3 shows a case of historic wires which have been collected, now all joined in one continuous circuit and containing sections of wires and cables which at various times formed parts of the most important electrical circuits in the history of electricity. At the top of the case is a piece of wire over which Prof. Samuel F. B. Morse sent the immortal first message by telegraph, *"What hath God wrought?"* Immediately below this specimen there is a length of a few inches of wire through which Prof. Alexander Graham Bell and Thomas A. Watson, his assistant, made all their early experiments on the telephone from 1875 to 1877, and through this wire passed the *first* electrical transmission of audible speech in the world in the year 1875.

The third of these historical wire mementos is a section of the Atlantic cable over which the first successful message was sent between the old and new worlds by Cyrus W. Field.

In the center of the photograph will be seen a safety fuse or plug used in London, England, on Jan. 12, 1882, to close the circuit of the first incandescent lamps ever lighted from an electric lighting central station in the history of electricity. This interesting event took place at the Holborn Viaduct Central Station, and it was Mr. Hammer himself who made the initial connection. Beneath the fuse is a portion of the first "Sprague" trolley circuit used at the historic plant at Richmond, Va., in 1888.

The sixth is perhaps the most interesting of all the relics, being a section of the deep-sea portion of the new American-Pacific cable, through which the initial "around the world" message was sent July 4, 1903, by ex-President Roosevelt. It is interesting to note that the Postal Telegraph

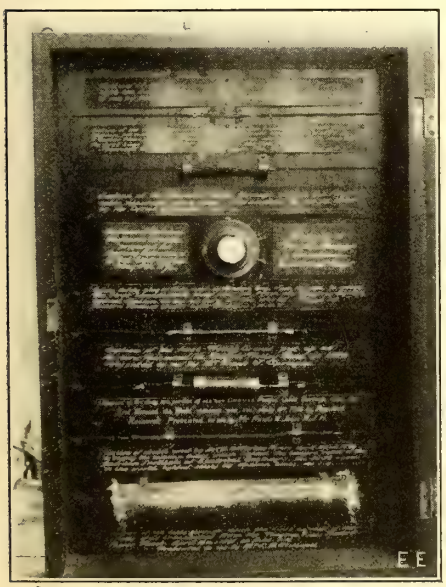


Fig. 3. Case of Historic Wires and Cables in the Wonderful W. J. Hammer Collection.

Co. borrowed this exhibit case of historic wires and connected it in the circuit. The message thus passed through all the old wire specimens. The seventh is a section of the wire through which the electricity was sent to illuminate the headquarters of the A. I. E. E. by Moore's system of vacuum tube lighting, this being the first room in the world so lighted. The eighth and last is a section of the cable through which the first electric current was transmitted from the Niagara Falls electric power plant, April 16, 1895.

Mr. Hammer is a fellow and life member

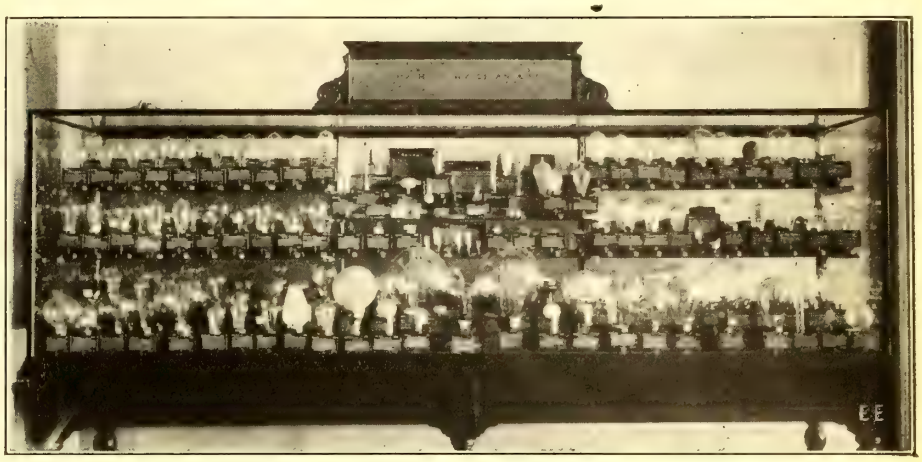


Fig. 2. Exhibit of Incandescent Lamps Prepared and Collected by Mr. Hammer. No Important Link in the Development of the Incandescent Lamp is Missing.

of the American Institute of Electrical Engineers, fellow of the American Association for the Advancement of Science and has been vice-president of the American Institute of Electrical Engineers, the New York Electrical Society and the Aeronautical Society of America and is a member of many other bodies. Also the Elliott Cresson and the John Scott medals of the Franklin Institute, the "Grand Prize" of the St. Louis Exposition of 1904, and several other medals here and abroad have been awarded this profound thinker and scholar.

Some of his numerous press contributions include a book on "Radium and Other Radio-Active Substances;" also special radium articles for the Encyclopedia Americana; editorial collaboration on the Aero Club's book, "Navigating the Air," and in conjunction with Hudson Maxim, the "Chronology of Aviation for the *World Almanac* of 1911 was compiled. This has since been reprinted and is the accepted authority upon the history of the art of flying. His multifarious duties have included that of secretary and expert of the Aeronautics Committee of the Hudson-Fulton Celebration of 1909, besides appearing for the famous Wright brothers in all their aeroplane patent suits.

Few men, perhaps, in their allotted cycle of life have been interested or identified with a greater number of engineering projects than this pleasant-faced man who counts among his innumerable personal friends the leading scientists and engineers of every country under the sun.

EDISON MEDAL GIVEN TO DR. ALEXANDER BELL.

Dr. Alexander Graham Bell, inventor of the telephone, was cheered long and heartily by a company that filled the auditorium of the Engineering Societies' Building, New York City, on May 18, where he had been summoned to the annual meeting of the American Institute of Electrical Engineers, to receive the Edison medal for meritorious achievement in electrical science.

John J. Carty, chief engineer of the American Telephone and Telegraph Company, made the presentation, after Prof. Thomas A. Watson, of Boston, mechanical expert for Bell at the time of the telephone invention in 1875, had spoken of some of the trials of the experimental period.

"The telephone has developed so much in recent years," Dr. Bell said in accepting the medal, "that I have almost forgotten my part in it. When I think of the present system I realize what other men have done, and how much we owe to them. To me Prof. Watson represents the past of the telephone, Mr. Carty represents the present and the American Institute of Electrical Engineers represents the future.

The question with me is: Are you not some day going to see by telephone? The end has not come. I am struck by the fact that nearly all recent developments has had to do with vibration. I wonder what it may not lead to, when our engineers turn their genius to some of the many other fields of the work."

EDISON PERFECTS THE TELESCRIBE.

(*Continued from page* 83.)

"Among the many uses to which the phonograph will be applied are the following: Letter writing, and all kinds of dictation without a stenographer; connection with the telephone, so as to make that invention an auxiliary in the transmission of permanent and valuable records, instead of being the recipient of momentary and fleeting communication."

Ground wires for metal mouldings must be of copper at least No. 10 B. & S. gauge.

SOME ELECTRIC LIGHTING RULES.

The following simple rules should be observed in considering lighting installations:

Don't work in a flickering light

Don't expose the eyes to unshaded lights in the direct range of vision.

Don't judge illumination by the brightness of the lamps.

Avoid extensive contrasts.

Use the right type of globe, shade or reflector.

Make sure that the illumination is sufficient.

Keep lamps, globes and reflectors clean.

Make sure that lamps are in the right position.

The Panama Canal was begun nine years ago and has cost $310,000,000; within the same space of time the Bell Telephone Company has spent twice that amount in its engineering construction work on the transcontinental telephone line alone.

New Inventions in Photoplays

NO—the photograph we see below is not that of a band of Chinese conspirators catching secret wireless messages! It depicts an interesting moment in the Pathé moving picture production, "The Exploits of Elaine," being from episode No. 21, entitled 'The Listening Ear."



The Movie Villain, "Wu Fang," and His Men Listen to "Craig Kennedy's" Conversation by Means of the Listening Ear, or, As We Know It, "The Detectaphone."

The story, of course, revolves about the leading characters of "Wu Fang" and "Craig Kennedy," the scientific detective. The Chinaman, "Wu Fang," pits his cleverness and scientific abilities against those of the well-known detective character in the story of the photo-play.

The vital moment here shown is that when "Wu Fang" manages to have his assistants install a "Detecta-phone," or as it is termed in the picture more mysteriously, "The Listening Ear," so that he and his assistants, who are located in the same building as "Craig Kennedy's" office, can overhear what he has to say to his assistant.

This picture is one of the most interesting, in several ways, of those so far shown in the famous Pathé film feature, and it is very exciting to see "Craig Kennedy" locate the hidden Detecta-phone wires in his office by means of the "Kennedy Galvanoscope." This galvanoscope is one of the largest ever seen in captivity, to put it mildly; but of course it is necessary to use large instruments which will show up in the proper way on film pictures, etc. To resume: When the instrument is brought near the hidden wires by "Craig Kennedy" the leaves of the galvanoscope, which measure about 4 inches in length, are seen to flap back and forth in a very *wonderful* manner. However, the general features of the instrument shown are undoubtedly brought out in a very strong manner, so that the uninitiated in the audience will be sure to gain the general underlying principle involved in the apparatus used.

An electrical device which has been mentioned a number of times in scientific journals in the past few years is that known as the Sphymograph, or the instrument which can record the state of human emotion. This apparatus is seen in the picture herewith presented, which is taken from the Pathé film entitled "The Exploits of Elaine" and depicts the famous characters of "Craig Kennedy," the scientific detective, portrayed by Arnold Daly, and "Elaine Dodge," in the person of Miss Pearl White.



The "Sphymograph" is Demonstrated to "Elaine Dodge" (Miss Pearl White) by "Craig Kennedy" (Mr. Arnold Daly). Scene in the "Exploits of Elaine," Pathe Film.

In the picture here presented "Craig Kennedy" is explaining and demonstrating the Sphymograph to "Elaine Dodge." Later this remarkable instrument is successfully employed to secure the correct address of the Chinaman, "Wu Fang," who is always scientifically scheming against the science and art of "Craig Kennedy."

The principle of this instrument is based on the fact that if a suspected person, such as a criminal, is successively plied with statements along the line of information desired, that when the correct indication is spoken, that the heart and therefore the pulse will invariably and faithfully momentarily increase in activity. The person's face may not show this (as is well known, of course, in the case of expert criminals), but, thanks to the Sphymograph, which consists of a sensitive microphonic contact arrangement strapped to the wrist of the person suspected, it is made possible for a sensitive galvanometer, seen in the picture, to throw its moving beam of light across the scale, which we also see in the illustration. For instance, in this "movie" story the young lady accomplice of "Wu Fang" is taken to "Craig Kennedy's" laboratory and when he has her placed in the chair the special wrist band is attached and the action taking place is as follows:

The detective repeats numbers on Pell street, where "Wu Fang's" headquarters are supposed to be located, and the series of numbers repeated begin with "1." When he has reached "No. 14" the Sphymograph faithfully records an internal change in the emotion of the young lady by swinging its beam of light from the galvanometer clear across the scale.

Thus it is seen that while the instrument does not read the human mind in the ordinary sense of the word, it truly does read it nevertheless, even though in an indirect yet positive manner.

This may be likened in a general way to the method used in the courts of India

(*Continued on page* 102.)

PASSAIC HAS A WIRELESS CLUB.

At the first meeting of the winter season, the Wegotta Radio Club, of Passaic, N. J., reorganized with three new members. The club started with five members two years ago for the purpose of advancing the knowledge of wireless telegraphy among its members and to bring together the operators of amateur wireless stations in Passaic and vicinity in order to discuss topics pertaining to radio communication and take part in lectures which are given from time to time at the club room.

All the members are licensed by the government to operate stations, and four have been appointed relay stations of the American Radio Relay League, which is an association of amateur operators whose stations make up a chain stretching the entire length of the Atlantic Coast and connect the Atlantic with the Pacific across the northern part of the country. Any of the operators of appointed relay stations may originate messages and thru this series of relay stations, send messages to almost any part of the country.

The Wegotta Radio Club of Passaic meets on the second and fourth Thursday of each month at No. 33 Pennington avenue. The secretary will be glad to hear from any one who is operating a wireless station and wishes to join the club. There are no dues or initiation fees.

The members are: T. E. Ackerman, H. V. Berger, J. L. David, R. Huerdin, C. N. Humprey, E. S. Pearl, W. F. Tense, J. M. Thomson, G. S. Yerbury.

HUGE TELEPHONE AT EXPOSITION.

The accompanying photograph shows a desk telephone set which measures 19 feet high. This gigantic telephone was placed in the rooms of the Western Electric exhibit at the San Francisco Exposition. This telephone in appearance is a replica of the ordinary telephone used every day. Compare it in size with the common desk set shown in the picture. This exhibit is one of the most interesting at the exposition. All kinds and styles of telephone apparatus are shown and demonstrated.



Mammoth Telephone Model Exhibited by the Western Electric Co. at the 'Frisco Exposition.

Uncle Sam's Battleships at Night

Many wonderful electrical sights were produced during the recent review of Uncle Sam's battleships on the North River, New York City. The photograph herewith shows two of the battleships illuminated with electric lights and the gigantic searchlights flashing their powerful beams of light into the night. Some of these searchlight beams were seen many miles distant. Note the illuminated star between the masts on the Battleship "Texas" at the left. Hundreds of horse-power of electrical energy were used in the lighting of the battleships, each one supplying its own power of course.



Photo (C) by International News Service.

Beautiful Effect at Night on Hudson River, New York, When Uncle Sam's Mighty Dreadnoughts Threw Skyward Their Powerful Searchlight Beams.

During their stay for the review a boat race took place at night, the river being well lighted by the searchlights of the fighting-ships. President Wilson was an interested spectator at the race, which was won by the husky crew of the mighty "Wyoming." A single searchlight beam marked the finish line for the boats; rather a novel race marker indeed.

The whole sky was alive with intercrossing beams of light during the evenings and a most beautiful effect, impossible to describe, was produced when, for instance, half a dozen searchlight beams were played in one direction over the sky, while a similar battery of light beams was played past them in the opposite direction. Some of the war vessels evidenced the exercise of great ingenuity in arranging spectacular illumination effects, which were highly enjoyed by the large crowds parading Riverside Drive nightly.

ELECTROPLATING WITH COBALT.

Probably no other paper presented at the spring meeting of the American Electrochemical Society is of such general interest as the one by Messrs. Kalmus, Harper and Savell, dealing with the electrodeposition of cobalt. This is on account of the facts brought out indicating that cobalt may well replace nickel in a great many applications where nickel plating is now used. For the past 20 years nickel plating has been widely utilized to protect other metals, such as iron, from oxidation, and to give a finished surface which would take a polish, have an attractive appearance, and not easily corroded. The performance of nickel has not, however, been ideal. Peeling of the nickel has not been uncommon, and oxidation is not unknown.

Cobalt is in appearance somewhat similar to nickel, but it has a bluish cast. Its specific gravity is about 8.8, or nearly the same as nickel, but its hardness is greater than that of either nickel or iron. This is a very desirable quality in a plating material. The electrical conductivity is slightly greater than that of nickel. As far as its physical properties are concerned, cobalt would no doubt be satisfactory as a substitute for nickel, and would have some advantages over the latter. Its wide commercial use will depend upon the cost of the metal and of the plating operation, the rapidity with which the work can be done, and the adherence of the deposit. The authors of the paper provide some interesting information on these points.

Where suitable plating solutions are used the deposits (on a variety of metals) are found to be firm, adherent, hard and uniform, and can be deposited at a much more rapid rate than is feasible with nickel.

Although wireless apparatus was not fully developed until 1909, it is estimated that over 6,000 lives have been saved by its use.

Baron Münchhausen's New Scientific Adventures

By Hugo Gernsback

Münchhausen On The Moon

BANG!!!
Bang! Bang! Bang!!!
Four terrible shots rang out.

A heart-rending moan—a piercing cry. Then a long, ominous silence.

BANG ! BANG !!!

Two more shots more terrible than the first ones.

"Dick!! Dick!!!"

No answer.

"Oh, Dick!!! . . . . . ."

Less answer.

The pine trees on the cliff moaned plaintively in the otherwise oppressive silence. Suddenly a lone owl hoo-hood sharply and simultaneously a flash of lightning illuminated a scene of overpowering dread. I looked on aghast—my hair stood on end. I trembled violently, for what I had seen there was so terrible, so dreadful, so awful that it is impossible for a human being to describe it. For that reason I must refrain.

* * * *

Now, honest, admit it. Was that not a good beginning? You can't deny that it grinned you. The trouble these days is that it is rather hard work to make people read stories. Most stories are not worth reading to begin with. You look at the heading and feel lukewarm. Then you read the first sentence and chances are you immediately form the opinion that the author is an insufferable bone head. At that, you may do him an injustice. He probably is only a second rate idiot. No matter, you won't read his stuff. That's where advertising pays. Put something real exciting at the beginning, even if it has no bearing at all on the rest of the story. Most anything goes, the more mysterious the better. Also—advice to authors whose rent comes due too frequently—the longer you draw it out the better. For the editor—unless he is an old crust and blue pencils most of it—will pay you real money for that dope unless, of course, his sense of humor has gone to smash entirely. Most editors' has.

(*Editorial Note.—We found it necessary to suppress 29 pages of Mr. Alier's manuscript here, as his remarks became entirely too personal and too caustic.—Editor.*)

Now it is a proven fact, supported by much evidence, that people in these days are fond of terminating things once started. Just so with a story. You begin reading a tale, no matter how painful, and once you have spent three minutes on it ninety-nine chances out of one hundred you will see it through to the end. It's like a good "ad." If once you are made to read the headline you probably will read the rest of it. It is the same with a story. Hence I beg your pardon for having taken an unfair advantage of you; in these times of fierce competition "us poor authors" must resort to unusual means, even if it is against all international laws. Just like the German submarine warfare.

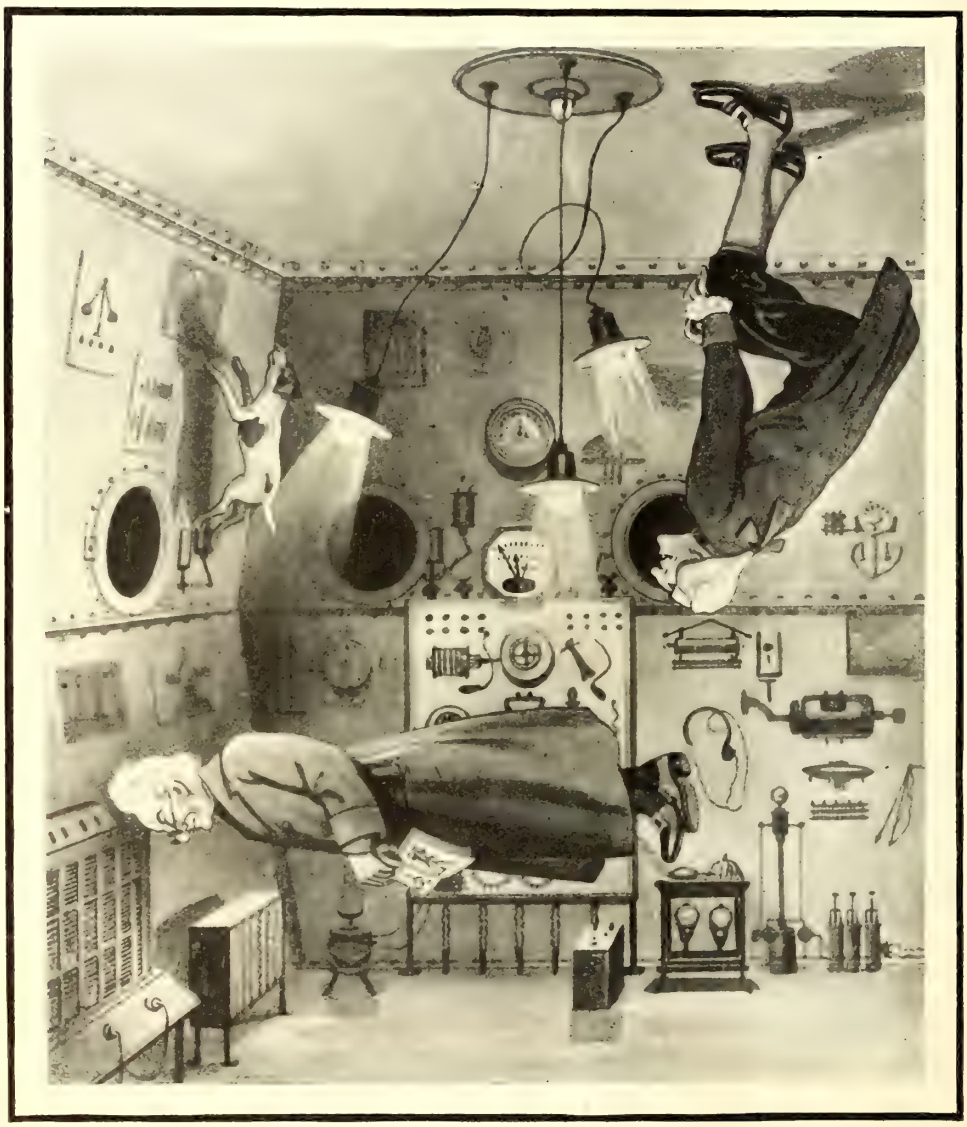
Of course, I must admit that the plan has its defects. For with female women it don't work. You see they are foxy. You can't fool them that easy. For they have a cantankerous habit of reading the end of a story first! They laugh up their sleeves—if sleeves are in style that season—and the poor simp of an author who thinks he is going to spring a big surprise on them at the very end has another guess coming!!

So the smart author double-crosses you and puts the real end somewhere in the middle of the book. Then on the last page he arranges for a tearful parting of the hero and the heroine, intimating strongly that the two will never, *never* be married. That leaves you guessing. For if you haven't read the entire story how were you to know that they really got married in the end (in the middle of the book)? But the smart author simply tacked on a few chapters—after the end—showing that the heroine didn't like the hero's liver and that likewise the hero objected to the heroine's gall and to the scent of her face powder. So after things became unbearable they got a divorce—at the end of the book. That's what I call good construction of a story. But to get down to business.

After I had dusted myself off and had made certain that the various members of my anatomy were still on intimate terms with one another I limped off in the direction of my home. As I was not in a hurry I took my time about it. I chuckled inwardly for the good reason that on account of my various bruises I dared not chuckle outwardly; as with General Joffre in France—time worked for me.

But I get ahead of myself again and being too indolent to rewrite this paragraph and putting it ahead of the one above you will have to read it as I wrote it. If you don't approve of that I suggest that instead of reading the first paragraph *first*, to read it *after* the ones that follow this. That will simplify matters considerably.

The facts are briefly these: At the very beginning of this story I have told you how I had been of immeasurable benefit to the human race. I told you how as president of the "American Wireless Mouse-Trap Co." I had rid the country of mice and rats. I had told you how far-famed I was for being the first man to talk all around the globe with my historic wireless telephone. The name of I. M. Alier is linked with the greatest scientists of the world. For that reason I did not think myself immodest when I went to see Mayor Ezrah



... he remained suspended in midair without anything supporting him

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IS the moon really a dead and barren world as our scientists contend? The most powerful telescopes can only scan the moon's surface, but we know nothing of the interior.

The versatile Münchhausen has been doing some exploring and he tells us a few things, which somehow, sound plausible. Incidentally, do you know that you can jump thirty feet high without much effort on the moon? If you don't, this story will tell you all about it,—and a good deal more.

Coddlemaker, of Yankton, the town of my birth, with a simple suggestion.

There is a small triangular plot at the intersection of Main and High streets. It had come to my ears that a syndicate had been formed to purchase this plot from the city with the object of opening a combination hot frankfurter, flower and barber shop there. As the city would have to erect a monument to my honor sooner or later, and as the site was ideal for this purpose, I went to the City Hall and told the Mayor so. I thought I might as well arrange for the monument during my lifetime.

Mayor Coddlemaker, who had always been a staunch friend of mine, received me warmly. While I explained my mission to him, the color of his usual pink face changed to that of a fresh boiled lobster. Then it went over to a delicate shade of purple. I know now that his inner temperature must have risen from 100° in the shade to 150° in less than two minutes. I began to feel sorry for him that he had neglected to attach a safety valve to himself; it would have been decidedly useful just then. Fearing that His Honor was about to blow up the City Hall with his own person, I tendered him a glass of water. This, however, did not have the desired effect on him, but instead he took on four shades deeper of a beautiful purple and emptied the contents of the glass in my face. Most of it went down the neck of Coddlemaker's secretary, who was working with his back turned toward mine. While I wheeled around to apologize to the secretary, Mayor Coddlemaker, who is an ex-prizefighter, took me by the nap of my neck and spun me around like a top. This seemed to limber him up somewhat, and he became so delighted that he tried me out as a carpetsweeper, my face forming the business end of the sweeper. His Honor then amused himself for some minutes in playing ball with me. I obliged him by taking the part of the ball. My sense of humor being sadly deficient, I failed to see the joke after awhile. I told His Honor so between my rapid trips up to the ceiling and down into the Mayor's fists.

He bellowed something about him and the town of Yankton being made the center of derision with that fool "Münchhausen" story of mine. He playfully added that the papers poked fun at him day and night for letting me stay out of the lunatic asylum. He also mentioned that Yankton had become a permanent feature in all the comic supplements of the country, that on account of my hair-brained story I had definitely ruined not only his career, but the future of the town as well. He gleefully remarked that he had been itching to lay hands on me for a whole month and he thanked me profusely for having satisfied his itch! Whereupon he dumped me in his waste basket and while his secretary held the door open His Honor emptied the waste basket with a flourish. Without waiting to apologize I took a hasty departure.

Now comes the paragraph where I had dusted myself, etc., etc. See above.

On my way home I sympathized deeply with Mr. Galilei Galileo, of Pisa, Italy. He once took a fool notion in his head and told the world that the earth was not standing still, as popularly thought, but that it spun around like a top! Whereupon the world poked fun at him and his fellow citizens playfully intended to burn him at the stake. But Galileo was a good talker and an elegant advertiser. He kept telling them *E pur si muove,* also what an advantage it would be to have the earth spin around, because everybody would get a ride for nothing, and on the trip around people would see lots of new scenery in the universe. He also was careful to tell them that if the earth was to stand still, there would be no seasons any longer and, furthermore, one side of the globe would have a perpetual day and the other side a perpetual night. If by chance Italy should come on the dark side—well, good night!!

So they thought it best to let Galileo have his way and passed a resolution to let the earth spin around indefinitely.

Not that I want to compare myself with Galileo. Far be it from me. I only mention it to show how misguided the world is at times. It was so in Galileo's times and is so now. In years to come my story about Münchhausen will be believed, just as Galileo's preposterous idea that the earth moves is universally accepted to-day.

Just now I am a martyr to a just cause. In due time Yankton will erect that monument for me, or my name is not I. M. Alier.

* * * * * *

Whatever Münchhausen's shortcomings might be, he certainly is prompt. If I were his wife I probably would adore him, for he is always on time to the second. If there were a Mrs. Münchhausen I am sure she never would have to wait with the supper for him. He would be there on the dot, or he would have a mighty good excuse, and be it said here, Münchhausen does not make excuses as a rule.

My clock had just began striking the eleventh hour that evening when, true to his word, Münchhausen "called." There was the familiar, piercing screech in my 'phones, growing louder and louder, and in another second communication between Münchhausen's station on the moon and my own station in the sleepy old town of Yankton, Mass., was once more established.

"Good evening, my dear Alier," it came in clear, deep tones, in that sepulchral voice I had come to cherish, "are you ready for our nightly chat?"

"Indeed I am, Your Excellency," I made haste to reply, "how is your health this evening?"

"Perfect, perfect, my boy. Never felt better in my life. The air up here is so invigorating that I actually grow younger each day!"

"But I thought there was no air on the moon, my dear Baron. I am real anxious to have you tell me all about it."

"Of course, I will tell you, but let me see, where did I stop last night..... Oh, yes..... I believe my power gave out when I told you of my first impressions after the *'Interstellar'* left the earth behind."

The moon overhead was full and we could almost see it grow larger as we rushed toward it through space at an incredible speed. Professor Flitternix and I had calculated that we ought to traverse the 240,000 miles separating the moon from the earth in about 104 hours. This is an average of 2,300 miles an hour and may seem excessive, but in reality it is but a low speed, as speeds go in the universe. The calculation is very simple, too, and well known to astronomers.

Nothing very eventful happened during the trip to the moon. Flitternix was busy with astronomical observations, while I was engrossed with the machinery most of the time.

For the first hour after our departure from the earth we tried to become familiar with the many odd phenomena which presented themselves to us, due to the sudden, almost total, absence of gravity.

The *"Interstellar,"* no longer subject to the attraction of the earth, due to its gravity insulator, was only subject to the moon's gravitational attraction. But as we were some 200,000 miles distant from that body its comparative feeble attraction had but little effect on our bodies in the inside of our flyer.

For, according to the law of gravitation, our 1,000-ton flyer weighed but 110 lbs. at this distance from the moon.

Flitternix was the first to find this out. He had been pointing to the planet Mars with his hand stretched out toward one of the glass portholes overhead. While I looked at this beautiful planet I suddenly heard Flitternix exclaim. He was eying his arm in astonishment. It was still outstretched, but pointing slightly upwards; this is what happened:

On earth his arm would have fallen down to his side of its own accord by the action of gravity, the arm weighing, let us say, 10 to 12 lbs. Inside of the *"Interstellar,"* with practically no gravitation, *his arm weighed less than* 1-10 *ounce;* furthermore, our feet were still pointing toward the earth, where there was no gravitational attraction, due to our gravity insulator. The only attraction coming from the moon overhead, *his arm was pulled slightly upward* by a force of less than one ounce. To bring his arm in its normal position it was necessary for him to use his muscles, which he did with a foolish grin.

We then switched on the entire Marconium netting, thereby insulating us from the moon's attraction also. We were now no longer subjected to any outside gravitational attraction of any kind. Still the *"Interstellar,"* due to its momentum, continued to move forward in space with its original speed.

Some curious phenomenæ were now observed by us. The mass of the *"Interstellar"* being relatively small, its force of gravity was but very minute. When you consider that on earth this globe, with its volume of 600,000,000,000,000,000,000 tons,

attracts my body with 170 lbs. to its surface you will understand that the volume of the *"Interstellar,"* with its 1,000 tons, in accord with Newton's law can attract my body with but an infinitesimal fraction of a pound. *Therefore, practically speaking, all objects within our flyer were without weight.*

For a while we amused ourselves with odd experiments. Thus I would lift up Flitternix with my little finger and place him on my outstretched palm; he weighed less to me than if he had been a child's balloon. Buster, my terrier, became careless and started to jump around, with the result that he went clean up to the ceiling with a thump. His body being elastic he came down with the same speed as he had gone up. There was another thump and he went right back to the ceiling once more with undiminished speed. He simply could not stop any more. He was like a rubber ball bouncing up and down. There being no gravitational force to retard his speed, only the air in the room as well as the friction of his body against the ceiling and the floor; this acted as a slight brake to take up his energy expended originally. It was, however, so slight that after he had bounced back and forth some 200 times, howling frightfully all the while, we took pity on him and stopped him with our hands. After that he became very careful in his movements and we found it wise to imitate him.

We had to move about very cautiously and very slowly; any attempt to walk quick, for instance, was disastrous. Like Buster, it was exceedingly difficult to stop ourselves once started. We could, of course, walk on the ceiling or on the sides of the room with as equal facility as on the floor, for the reason that there is no "up" or "down" in free space. You could lay down most anywhere without danger of falling or even rolling. As our bodies had no weight, it mattered not where we lay down, either. Thus, stretching yourself out, with nothing but the sharp edge of a chair supporting your back, was as comfortable as laying on your cot. You see you weighed nothing, consequently your body could not press down hard on anything, and for that reason you could not possibly feel uncomfortable no matter how you rested.

The most delightful experiment, however, was when I took Flitternix and brought him to the center of the *"Interstellar"* while he was sleeping. Taking my hands away from him he remained, of course, where he was, i. e., suspended in midair without anything supporting him. There being no gravity he could not fall down nor up, for that matter. I then walked on the ceiling and called him. In a few seconds he woke up. I think he must have been the most surprised man in the universe just then. He began clawing the air and looked wildly about him; you see he thought he was still on earth and he imagined he was going to fall down! That goes to show how strong habits and instincts are. In a few seconds, however, he remembered where he was and "sat up." He certainly looked ludicrous sitting suspended there in midair begging me to pull him either up or down. I was so convulsed with laughter at his helplessness and the situation was so droll that I resolved to see the experiment through; for that reason I told him that I refused all assistance. By that time he had become interested in the situation himself and after thinking a little while he began jerking his body back and forward in the fashion of an acrobat on a swinging trapeze. This gave his body sufficient momentum and in a few seconds he had landed laughingly on the opposite wall."

I had listened to the Baron with amazement, but I knew that what he had said coincided with Newton's law of gravitation. There was, however, one point which I had revolved in my mind and which was not clear so I commented:

"What you have just related is certainly exceedingly interesting, my dear Baron, but there is one point I would like you to elucidate: How did you finally effect the landing on the moon?"

"Not so impatient, my dear, I was just coming to that. When at the end of the 100th hour we were but some 600 miles from the surface of the moon, which by this time had become so big that it filled up most of the sky overhead, we switched on the portion of the Marconium netting turned toward the moon. The other half of the netting, which heretofore had insulated us gravitationally from the earth, was then switched off. Now the earth began pulling us again and in a few minutes, with our momentum expended, we were going earthward once more.

Immediately we reversed the currents in the Marconium wire netting, with the result that we fell toward the moon again. In this manner, by manipulating the Marconium netting, I could vary the speed as well as the direction of the *"Interstellar"* at will and within a short while we were

SYNOPSIS

I. M. Alier, an eccentric young scientist of Yankton, Mass., who claims as his own many new as well as startling inventions, far ahead of anything as yet discovered, owns the largest radio-telephone plant in the country. One evening he hears strange noises over his phones and immediately a sepulchral voice is heard. It is Münchhausen, one of the greatest yarn and story tellers of all times. Münchhausen explains how it came about that he did not die in 1797, as popularly thought, and he furthermore gives unrefutable proof that his home is on the moon at present.

Alier wants to know why Münchhausen went to the Moon and how. The latter then explains how Prussia persecuted him and how he went over the the Allies and succeeded in capturing Berlin in a wonderful manner. However, it was not a complete success, so the Baron left Europe for America. He immediately constructs a machine which is to take him into space to the moon. Münchhausen has discovered how to neutralize Gravity by means of Electricity, and he applies this invention to his space flyer, the *"Interstellar."* The machine proves a success; it responds and is lifted with tremendous speed towards the moon.

THIS STORY STARTED IN THE MAY ISSUE. BACK NUMBERS WILL BE SUPPLIED AT 10c. EACH POSTPAID.

but a few miles distant from the moon's surface. We carefully scanned its rugged face with our glasses and we finally decided to make our landing in the plain known to astronomers as *Mare Nubium.* This plain, which in past aeons undoubtedly was part of an ocean, but now devoid of all water, measures several hundred miles across and in some sections it has a very level appearance; moreover it looked sandy like a desert through our telescopes and we decided that we could probably make a successful landing there.

By carefully manipulating the switches controlling the Marconium wires the *"Interstellar's"* wide landing belt finally rolled gently over the volcanic sand of the moon and the flyer came to a dead stop 102 hours after leaving the earth.

It was a supreme moment. We were the first humans to land on the moon and we were naturally quite overcome with emotion for some time. Had I not been the first to conquer space and break away from the earth? Was I not the Columbus of a new world, a world far greater than any explorer ever discovered? Had I not opened the door of the universe that had been locked to all mortals since the beginning of our little world? Had I not thrown off the fetters which chained humanity to its poor, sordid planet for aeons?

I think I had a right to feel elated.

However, hard work lay before us. For centuries it had been the conviction of scientists that the moon was a dead world, devoid of any atmosphere, water and vegetation. Of course, in the absence of these three necessities life could not exist. This we realized only too well, but at best the earth's scientists had no absolute proofs; after all, their conclusions were but theories, although very plausible as well as convincing theories.

Knowing all this we proceeded very carefully. The first test we made was naturally to ascertain if there was any atmosphere on the moon. This test was very simple. We opened a small stopcock leading to the outside and we then listened with strained ears. We had tried the stopcock test out in space midway between the earth and the moon and the air had been drawn out with a loud hiss. While we were listening now there was no hiss, but we could feel the air being drawn out strongly from the *"Interstellar"* when placing the finger on the opening of the stopcock.

From this we concluded that there must be some kind of an atmosphere on the moon, although probably a very rarefied one. This relieved our anxiety immensely and I suggested at once to test the lunar air on Professor Flitternix's canary bird, Pee-Pix.

This was met with violent opposition by Flitternix, who made the counter-suggestion to try it on the dog first, the dog being Buster, my fox terrier. This suggestion was not met with wild enthusiasm by myself either, and a deadlock followed. Finally, however, we drews lots and I lost. Buster therefore was the first terrestrial being to inhale the lunar atmosphere.

With a heavy heart we placed him into the ejector and closed the door behind him; he was now in the air lock. By moving two levers the outside door of the ejector was opened and Buster was in the moon's atmosphere. In another second he had hopped to the ground, anxiously watched by us through the glass plate portholes.

We saw him sniffing at first, whereupon he began coughing violently for some minutes. After that he seemed to become quieter and he commenced to walk around in a curious, excited manner, as if under the influence of a drug.

We could not understand this, but continued watching him with concern. Within an hour, however, he seemed to have become acclimatized and he behaved normally.

I reasoned that if Buster could stand it we could, and I said so to Flitternix. The professor was of the same opinion and we decided to risk it. We opened the door carefully, leading to the outside, drew a deep breath and stepped out. In another second we had landed on the moon.

The first sensation was a strong ringing in our ears and the curious sense of lightness of our bodies. The latter sensation, however, was not new to us, as we had experienced it already in the *"Interstellar,"* due to the absence of gravitation. We now took a careful breath and started to cough violently at once. Nor could we stop it at once. The "air" which we inhaled

(*Continued on page* 122.)

Electricity Helps to Heal German Soldiers Wounds

THE photograph shows a number of wounded German soldiers under expert treatment in a hospital for the wounded. As will be seen, some of the soldiers have their arms inserted in an electric heating oven, and it has been found that this heat treatment acts very remarkably to remove stiffness from the joints and muscles.

The temperature of these ovens is very carefully watched by means of the thermometers, and the soldiers receive this treatment at regular periods each day until they are thoroughly well and ready for the front again.

The electric ovens shown have been used considerably in hospitals and sanitariums with great success. They comprise an electrical heating element composed of a wire or ribbon resistor, which becomes heated to different degrees when the electric current is applied, depending upon how the different sections of the heating element are connected to the line wires.

As seen, each heater has a marble switchboard on same which contains the different switches for adjusting the amount of current used, and which, in turn, permits any degree of heat wanted to be had readily.

Some of the electrical ovens for this purpose are much larger than the ones here illustrated and are adapted for heating the entire leg, etc. Also some of the ovens are built in such a shape that the abdomen or back of the patient can be heated as well.



Photo (C) by Underwood & Underwood.

The Kaiser's Wounded Soldiers Make Use of Electric Ovens to Limber Up Their Stiffened Muscles.

LOCATING SHELL FRAGMENTS IN WOUNDS.

A method of localizing shell fragments or other pieces of magnetic material in the human body, which has recently been tested in France, is noted in the *Engineer*. A powerful alternating current electro-magnet is brought near the region affected, and the presence of a magnetic body within the flesh is indicated by a perceptible trembling of the surface at the immediate locality. By feeling the flesh the surgeon can easily find the spot where the trembling is strongest, and can thus locate the fragment of projectile with considerable accuracy.

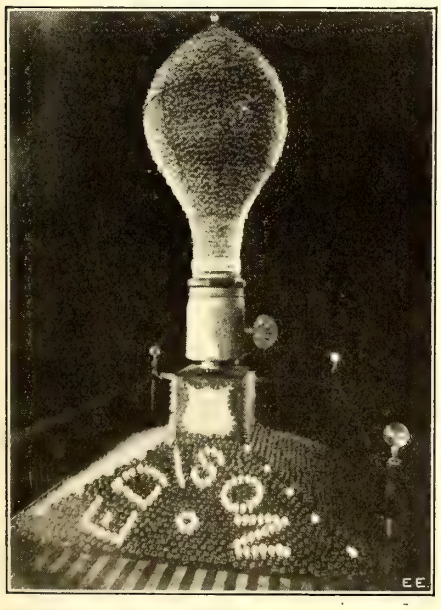
The action of this alternating current method of locating pieces of iron or steel which may become buried in the flesh, is based upon electro-magnetic induction set up in the iron particles or fragments, due to the powerful alternating magnetic field of flux created by the A.C. magnet.

The pieces of iron thus manifest magnetic qualities, owing to the current set up by induction in them and, of course, will also manifest movement, the same as the action taking place in an A.C. motor, etc.

Other methods in use consist of the X-Ray, the Induction Balance, etc.

ELECTRIC BULB COMPOSED OF 16,000 LAMPS.

A huge electric lamp, herewith shown, was built for the Cincinnati Exposition in 1888. This lamp consisted of a form or frame made of wire and having 16,000 electric lamps fastened on it. The "filament" consisted of a 3-inch pipe bent in the form of a regular filament, and red electric lamps were built upon it. When the red lamps were lighted their rays penetrated the glass of the outer electric bulbs and gave the appearance of a *real* gigantic lamp. This photograph is from the wonderful collection of William J. Hammer, the eminent electrical engineer and for many years the associate of Thomas A. Edison in the development of the incandescent lamp.



An Early Edison Exhibit in the Form of a Monster Lamp Bulb Containing 16,000 Regular Size Bulbs.

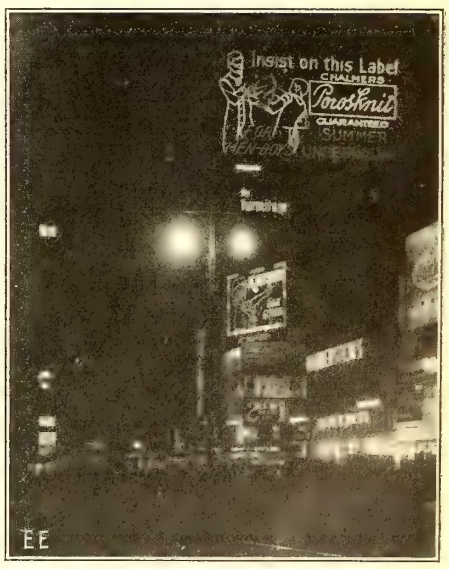
SELF-INDUCTION OF SOLENOIDS OF APPRECIABLE WINDING DEPTH.

At the April 23 meeting at the Imperial College of Science, London, a paper by S. Butterworth was read having the above title.

The existing formulæ for coils of this type, viz., those of Rosa and Cohen, of the U. S. Bureau of Standards, Washington, D. C., are shown to be inaccurate, the error amounting to one-fifth of 1 per cent. for the best formula when the winding depth is one-tenth the diameter of the coil. For greater winding depths the error is larger. The inaccuracy in Rosa's formula is due to the neglect of curvature in correcting for thickness, while in Cohen's formula the error is due to the approximate method of development. New formulæ are developed by methods which are free from such approximations, and which apply to any coil for which the length is greater than twice the diameter, and the winding depth is less than one-tenth the diameter. These formulæ are capable of giving eight-figure accuracy. Simplified formulæ are also given which are suitable when only four-figure accuracy is required.—*The Electrican*, London.

NOVEL "BOXING BOYS" ELECTRIC SIGN.

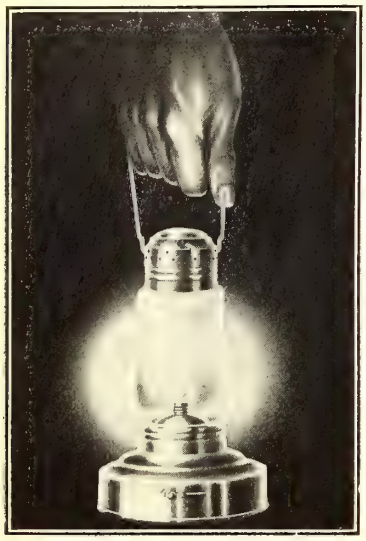
A spectacular electric sign, having rapid action to hold the attention of the public, is shown in the illustration herewith. This sign is one of the many marvelous attractions along the "Gay White Way" of New York City.



Electric Sign in New York City Featuring the "Boxing Boys" of Porosknit Fame.

THE FRIAR'S ELECTRIC LANTERN.

A new electric lantern herewith illustrated was recently put on the market. The lantern has the shape of an old-style oil lamp in which the oil fuel has been substituted by the modern dry battery, thus



Neat Electric Battery Lamp Known as the "Friar's" Lantern.

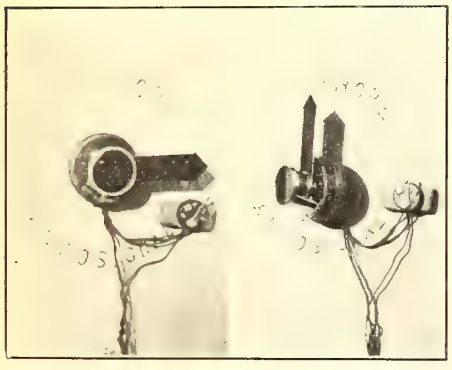
eliminating the accompanying dirt and danger occasioned by the use of oil.

The battery of this lantern is guaranteed by the manufacturer to give five hours continuous and 10 hours intermittent service, and while the fuel is not quite as cheap as in the old-style oil lantern the compensating features of neatness and safety in the new Friar's lantern make the difference in cost well worth while. A handy switch on the base enables the user to turn the light on or off.

A telephone call is ordinarily answered to-day in from three to five seconds. In the first exchanges it required from two to three minutes, and often a great deal longer. Such service would stagnate the present business world.

ELECTRIC SIGNAL FOR AUTOMOBILES.

An electrical signal to show the direction in which an automobile is to turn at street corners has been invented by a California man. An arrow-like indicator arm, rotat-



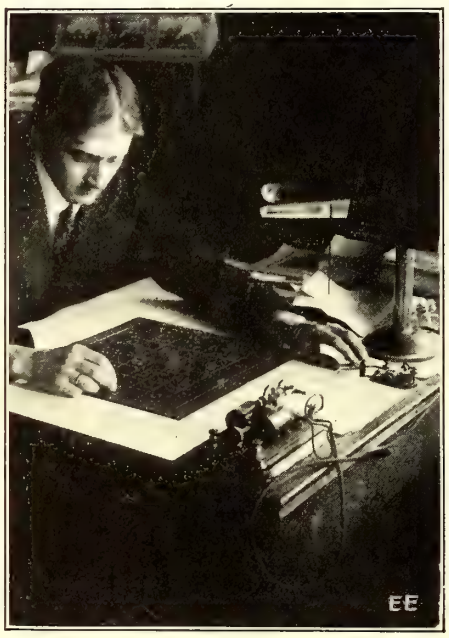
Two Views of New Electric Automobile Signal.

able from a normal vertical position to either right or left and operated by electromagnetic control, indicates the direction to those in the rear that the vehicle is about to veer off in. An electric lamp at the hilt of the reflector blade adds to the usefulness of the device at night.

PLAYING CHECKERS BY TELEGRAPH.

Exciting checker games by telegraph are not uncommon, and after the heavy work in the depots of many Western railroads has been transacted and the weary night operators return to their rooms to report the train either departed or passing by, the sounders click off mysterious numbers, which recently have been solved as checker tournaments by wire, the contestants being telegraphers located many miles apart. Many times checker games are in action over entire railroad divisions.

The accompanying photograph shows the operator putting the telegraph to good advantage in a very exciting game. The system used is very simple. An ordinary checker-board is marked from 1 to 32, inclusive. Two sets of checkers are used by each operator. At the start of the game the operators decide on who is first to move. The first mover clicks off in the Morse code as follows: "14 to 19, or 13 to 18," or vice versa, or according to the side of the board he chooses. Usually the operators decide in advance whether they have selected the red or black. When a king is made it is flashed over the wire, and although the contestants are far apart,



Playing Checkers by Telegraph.

yet the game is as interesting as if they were seated opposite each other at the same table. Frequently other operators along the line put their boards in action and *watch the game* by following the numbers as they come over the wire, moving the checkers on their boards accordingly. The operators say it is a great pastime.

TIFFIN RADIO CLUB.

A new radio organization was organized recently in Tiffin, O., with five charter members and has great promise of rapidly enlarging its membership.

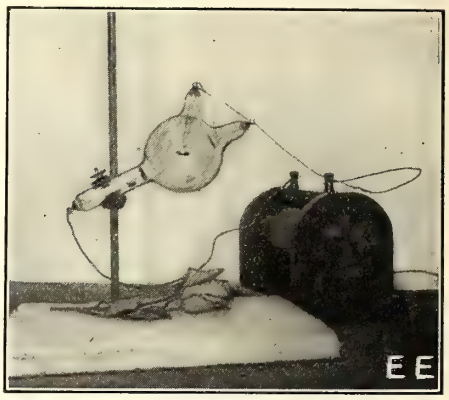
The officers elected are: President, John Grossman; vice-president, Paul Frederick; secretary and treasurer, Harold Buck.

It is desired that all wireless experimenters living within communicating range of this club correspond with the secretary in order to widen the influence and activities of the organization.

Black asphaltum is excellent for painting wireless instruments on account of its good insulating qualities.

THE STUDY OF FLOWERS WITH THE AID OF X-RAYS.

The applications of the X-rays to the study of phenomena invisible without their aid continually increase in number. One of the latest scientific uses found for these rays is in studying the inner structure of flowers and fruit buds. In some respects this is a better method than dissecting for



Studying Flower Growth and Structure by Means of the X-Ray.

the study of certain parts of plants, especially while growing.

The photograph here shown is that of a rose being examined by the aid of X-rays which are produced by the X-ray tube placed above and connected to a high-tension induction coil. The flower is placed on a box, which may be a plate-holder, containing the photographic plate.

Although most electric motors contain iron cores in their magnets some motors do not have any iron in them, as those, for instance, used in recording watt-hour meters.

It is now possible to transmit and receive eight distinct telegraph messages over a common circuit of two wires.

A FLASHLIGHT FOR THE PENCIL.

While there have been many novel applications made recently of the electric flashlight, probably one of the most useful for literary people, such as reporters, etc., is that shown in the illustration, and embodying a complete miniature electric flashlight with battery, adaptable to a pencil.

A simple switch on same enables the user to utilize the light whenever desired. This device is extremely small indeed and can be carried in the pencil pocket without any



This Ideal Pencil for Reporters Carries a Small Electric Light of Its Own.

undue bulging. One battery will last a few months with ordinary use. Such a pencil light is just the thing for taking down notes in theaters, where the auditorium is darkened; besides, it has many other useful applications.

LUMBERING TELEPHONE SIGNAL SERVICE.

By Frank C. Perkins.

The accompanying illustrations, Figs. 1 and 2, show the telephone refinement of the signaling systems used by lumber producers employing the long haul or pull boat method of skidding. This is said to be the quickest and only positive mode of signaling between drum man and tong man, and it is pointed out that instantaneous and accurate signals by telephone assure increased efficiency and decreased expenses.

It may be stated that every large lumber producer in the country, especially those using the out-haul system of logging, either the ground or cableway skidders, has been sorely pressed for an efficient method of signaling, which would be both positive and instantaneous, between the tong man in the woods and the drum man on the skidder. Every conceivable way has been tried, as, for example, the whistle signal, in which a string or cord is dragged out into the woods and is pulled to blow the whistle on the skidder. This has also been tried with a bell instead of a whistle.

Railroad signals were experimented with and, last of all, hollering was tried. This was done by placing a signal man or flag man near the tong hookers, who could signal to a man located near the engine, who in turn would signal the engineman. After numerous trials, each was thrown aside as useless. Still, some companies are doing the best they can by combining the railroad and the hollering signals, but these are far from satisfactory. Some companies have even given up the out-haul idea, on account of the lack of proper signaling apparatus. Every lumberman knows just how slow and inaccurate these modes of signaling are, especially where the out-haul skidder is in use.

There has now been designed special telephone instruments which have solved the problem of signaling for the lumberman. By means of this system the tong man and drum man can talk to each other at all times, regardless of whether the skidder engine is running or not, and it works successfully whether the tong man be 100 feet or 4,000 feet from the skidder.



At Left: Fig. 2. Lumberman Using New Type Telephone Especially Designed for the Purpose.

Below: Fig. 1. Lumberman's Type Telephone Recently Put on the Market.



The telephone service consists of a steel reel or drum, placed or mounted on the skidder, together with the instruments. On the drum are 2,000 to 4,000 feet of strong heavily insulated wire made for this purpose. There is continuous connection at all times through this wire by means of a brass commutator.

The head telephone set is connected by a plug and jack, and can be disconnected instantly. This set is very light and leather-covered to protect it from steam, grease and sparks, and is never in the way of the drum man when running the engine, and allows him to have both hands free. No batteries are used with either set, so the cost of maintenance is practically nothing. They work on the permanent magnet system. Either party can call. Should the tong man desire to talk to the drum man while this plug is out, he can be signaled by pushing the button and turning the crank on the field set, which will ring a bell inside the skidder set, notifying the drum man that he is wanted. He can then plug in and talk.

ELECTRICAL NOVELTIES FOR THE BANQUET TABLE.

By Felix J. Koch.

Down Cincinnati way hostesses *do* seem to possess the knack of getting up novelties—things that will appeal and yet which are different from anything anyone may have seen, just exactly the same theretofore.

So not long since, when young Jack Roosa was to celebrate his graduation from the medical college at the Queen City—and this with a banquet to his friends—his big sister, to whom he left arrangements, conspired with the toy dealers and the electricians of the town, with results as shown in the picture.

Up at the table center there was a great bowl of cosmus—just a plain vase, it seemed—and you never would guess that the base of that vase was an inverted bowl, or cave, within which a central plug could be placed for wires radiating out from between the grooves of the design on the vase. Five minutes' survey of the cheapest vases in any china store will supply you with such, of course.

These little electric wires—neatly insulated with green, that could be concealed beneath the flattened ferns on the cloth or among the lines of smilax—led, each in turn, to an inexpensive skull of papier-mache, supplied by the toy store, and there lit up a wee little bulb light, alternate red, then deep green.

These skulls in their turn were placed upon paper napkins of Hallowe'en patterning—witches, dark nights, Jack o' lanterns—likewise from the toy store. Otherwise, ferns and smilax, a carnation for boutonniere at each place, and the table was done.

When ready for serving, all lights save those in the wee skulls were extinguished. The little lamps cast their subdued rays through the hollow eyes on the place-cards beneath; and by aid of these, and these only, the young "medicos" found their places and enjoyed their first course—the initial one of a season of revel and fun. The picture shows the table ready for the guests.



Electrically Lighted Skulls, Figures, etc., Make a Novel Banquet Table Display.

A NEW ELECTRIC DISHWASHER.

A new electric dishwasher has recently been placed on the market.

Fig. 1 shows the dishwasher permanently connected in a kitchen. On the shelf at the left a rack of dishes is seen ready for washing. At the right a basket is shown in which glasses and silverware are placed.

In Fig. 2 the interior of the machine is shown with the rack of dishes and the basket containing the glasses and silverware in position.



Fig. 1. Electric Dishwasher Installed in Modern Kitchen.

Beneath the circular tank a ¼-horsepower electric motor is direct-connected to a small centrifugal pump, which forces hot soapy water through a perforated pipe in the center of the machine and out over the dishes until they are perfectly clean.

The dishes in the machine being above the water level and in a vertical position, the water drains off, while the combined heat from the direct contact with the hot water and the contained heat in the tank dries the dishes.

During the entire operation of washing, rinsing and drying, which takes less than five minutes, the dishes remain stationary in the machine, thus eliminating any danger of breaking or chipping.

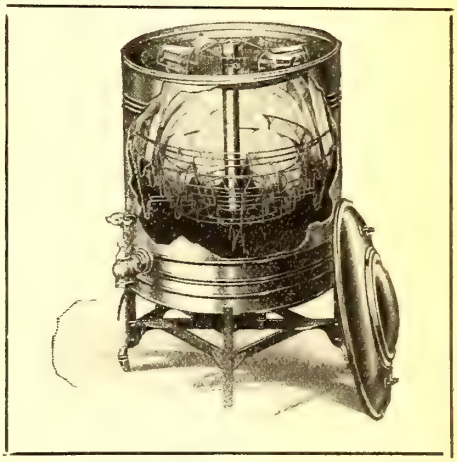


Fig. 2. Showing Dishes Placed in Electric Dishwasher.

AN "ATTRACTIVE" OLD MAN.

Different from the immortal "man with a hoe" is the man pictured in the illustration, who is kept busy walking around the yards of the Willys-Overland Co. at Toledo, O. By means of his trusty steel magnet secured to a shovel handle he man-



"The Man With a Magnet" Picks Up All the Nails, etc., in a Western Auto Plant's Yard.

ages to keep the roads about the auto plant clear of small iron or steel fragments which might puncture the auto tires. The magnet picks up all the nails, chips, etc., and which are then removed from the magnet and deposited in the pail.

HOW TO PRESERVE YOUR ELECTRICAL EXPERIMENTER.

No doubt many subscribers to *The Electrical Experimenter* keep the back numbers for future reference for the purpose of constructing instruments described in them, etc. Frequent handling while looking up the desired information soon renders the magazines ragged and worn.

To prevent this, get some manila paper folders, such as are used for music, and place the magazines in them. One or more copies may be put in each folder, as desired. Mark each folder so that you can see which copy or copies are enclosed. Then arrange the folders in the order in which the magazines were published.

This method, in connection with a card index, saves considerable time in hunting up any instrument or apparatus described in any issue, at the same time preserving them. Contributed by

WILLIAM H. SCHMOLL.

Dry cells should never be connected up with accumulators; the effect of the arrangement might be expected at first to light the lamps to an unusual brilliancy. Very quickly, however, the dry cells will become exhausted and then they will act as a dead resistance to the passage of current from the storage battery to the lamp.

A PHONOGRAPH-TELEPHONIC LECTURER.

An exceedingly ingenious phonograph-telephonic lecture system has made possible a wonderful reproduction of the Panama Canal at the Panama-Pacific International Exposition. This remarkable replica of the canal gives the visitor a more intimate perspective of the entire Canal Zone than is perhaps possible by a trip through the canal itself. This canal, in miniature, covers an area of four and one-half acres, and is accurately and minutely made to the smallest detail.

In order to facilitate the inspection of this gigantic model, an endless moving platform circumnavigates it. The platform is 1,147 feet long and consists of 144 cars, which are propelled by electric motors. Each car is equipped with seats for the passengers, and each seat is equipped with a pair of *Western Electric* watch case 'phones attached to an adjustable handle, through which one can hear a continuous descriptive lecture as the trip is made around the canal model. Fig 1 shows the type of 'phones used. This special type of handle was designed so that the spectators would not be obliged to hold their arms in an uncomfortable and tiresome position, and to prevent the necessity of removal of hats on the part of the ladies. Fig. 2 shows the telephone equipment installed on one of the passenger seats.

A telephone transmitter is connected to an Edison phonograph, which contains the lecture and reproduces it into the transmitter. This transmitter is connected to 42 receivers, and thus 42 passengers are connected with one phonograph. There are four of these units in the system.

This is the modern way of lecturing.

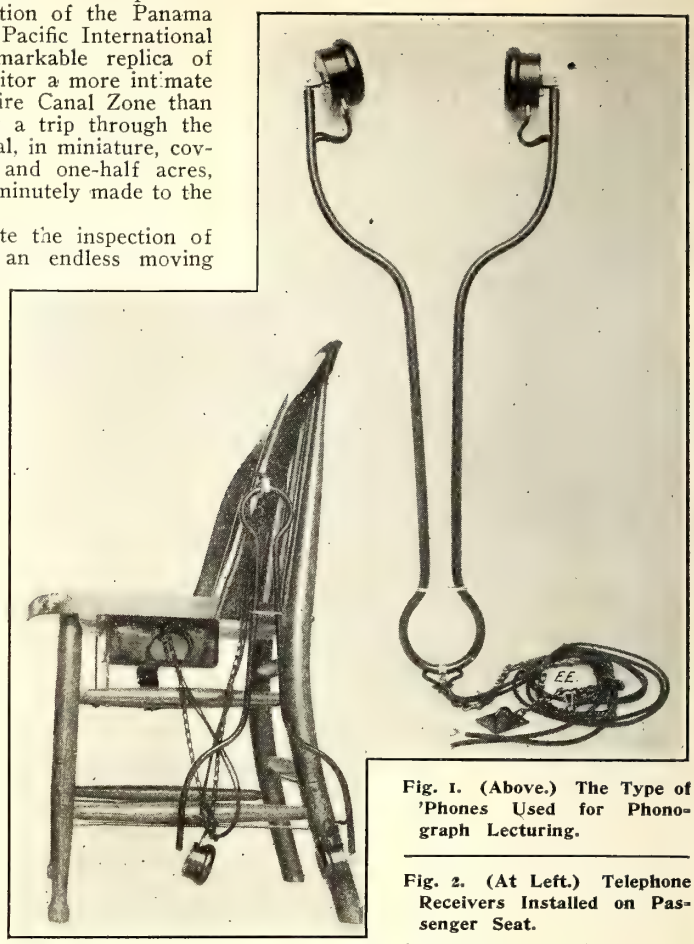


Fig. 1. (Above.) The Type of 'Phones Used for Phonograph Lecturing.

Fig. 2. (At Left.) Telephone Receivers Installed on Passenger Seat.

AN ELECTRICALLY HEATED SHOE-TREEING IRON.

The electrically operated shoe-treeing iron or "Calorel" re-laster, as it is called, which is illustrated herewith, is designed for use in retail shoe stores and can be operated from an ordinary lighting socket. It consists of three parts rigidly fastened together—the highly polished brass tip, the heating element, and the handle, which is of nickeled-steel wire. The brass tip weighs 1 pound and is able to store a comparatively large amount of heat. The device is equipped with 10 feet of flexible cord and a detachable plug, and takes 80 watts. At the average price for electric current it can be operated for less than half a cent per hour. It should be of great service to all shoe dealers in aiding them to make shoes look and fit their best.



A Flexible Electrically Heated Re-Laster for Shoes.

TO DISTINGUISH DIRECT FROM ALTERNATING CURRENT.

In case of uncertainty the following very simple method may be used to ascertain whether an electric lamp is supplied by direct or alternating current. Stand at some distance from the lamp and wave a stick to and fro between it and the observer's eye. If the current is direct (continuous) no distinct image of the stick will be seen, but only a blur. But if the current is alternating there will appear to be a number of sticks. This is due to the fact that an alternating current reaches a maximum and falls to zero in very rapid succession. A similar effect may be observed in a darkened room if an induction coil with bright sparks passing between the terminals is substituted for the lamp.

The energy freed by cooling one spoonful of water one degree would operate a telephone for ten thousand years. This baby current of electricity must take a voice 3,400 miles, and it cannot be increased or its power to transmit speech is gone.

LOCATING BURIED PIPES ELECTRICALLY.

Where will we strike an underground pipe? The haphazard plan of drilling and chopping the soil has never been satisfactory, and some means of determining the presence of underground pipes before boring into the soil have been sought ever since underground pipes have been in general use.

An apparatus which will determine the exact location of metal pipes, conduits, cables, etc., that are 12 feet or less underground is shown in Fig. 1.

The apparatus consists of an induction coil delivering a medium voltage, batteries, telephone receiver and an exploring or feeling coil.

The apparatus is used as follows: Terminals of the instrument are attached to a pipe at some accessible point. Then the operator holds the exploring coil in his hand as shown in Fig. 2, and holds the receiver to his ear. He now walks about, holding the exploring coil near the ground. The vibrator is then started on the coil. The humming of the vibrator is heard in the receiver, but as soon as the operator comes anywhere within the area enclosed by any pipes the humming in the receiver will decrease, and over the pipe no hum at all will be heard. The operator then knows that the pipe is within this area where he stands.



Fig. 2. Proper Method of Handling Exploring Coil When Tracing Path of Pipe.

The whole device is portable and can be carried about readily. It operates on batteries and sells at a reasonable price.

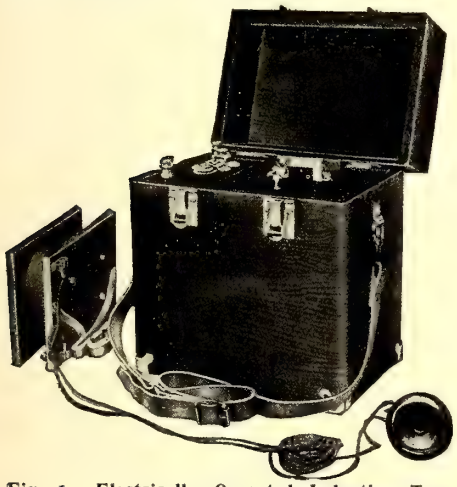


Fig. 1. Electrically Operated Inductive Type Buried Pipe Finder.

Russell Hoffman, of New Lexington, Ohio, writes us:

"I received my first issue of *'The Electrical Experimenter'* and think it is the best magazine I ever read."

A. S. Burleigh, of Great Falls, Mont., writes us as follows:

"*The Electrical Experimenter* has sure been worth 50 cents during the past year."

Tungsten lamps give about three times as much light for same current cost as carbon lamps.

Liquid air boils water and burns violently when ignited by a match.

THE SUN, THE BASE OF ALL ENERGY.

In this age of scientific wonders, we are perhaps, at times, apt to forget where the base of all energy in various forms is located. This central dynamo, if so we may term it, is the Sun, which is constantly giving off energy in the form of very rapid heat waves, transmitted through the medium we now call the ether. The ether transmits light, heat, wireless and other waves by vibration according to the theories now accepted, and when a body intercepts these waves they manifest themselves in one form or other.

Says D. Albert Kreider, Ph.D., of Yale University: "All heat, natural or artificial, is traceable to the sun as the original source. By the ancients the sun was regarded as a huge ball of fire.

When one remembers what a small speck in the universe the earth is, and how far it is from the sun, it will be evident that the earth can intercept only an infinitely small portion of the total heat which the sun radiates. Nevertheless, at the earth's surface this is at the rate of about 7,000 horse power per acre! How then can such an enormous loss of heat by the sun, without cooling, be accounted for?

The answer is that the sun is constantly contracting.

Anyone who has ever pumped up a bicycle tire knows that the compressing of a gas, heats it. Now the sun is still gaseous and is compressed by its own enormous force of gravitation. This force is 27.5 times as great as that of the earth. To illustrate: a person whose weight here is 110 pounds, at the surface of the sun, would weigh 1½ tons. But the sun can contract only as it loses heat; and thus it provides a nice balance of forces which maintains the temperature. Obviously this contraction can not go on indefinitely. It has, however, gone on for hundreds of millions of years in the past and may continue for millions of years to come.

The sun is an enormous mass, 866,500 miles in diameter, which is 109½ times the diameter of the earth. Calculation has shown that a contraction of only 250 feet per year is sufficient to account for all of the heat energy which it radiates. At this rate the contraction could continue for 9,000 years before the most powerful telescope could detect the consequent change in its diameter. It must be remembered that the earth is 93,000,000 miles from the sun.

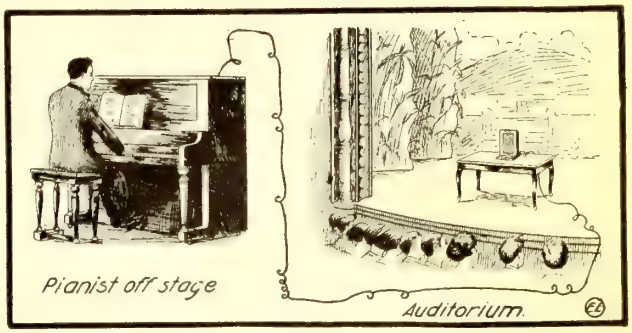
FINAL CALL

Beginning with July 1st the subscription price of THE ELECTRICAL EXPERIMENTER goes to $1.00. *It is to your interest to subscribe now while the price is so low.*

THE ELECTRICAL EXPERIMENTER is the greatest value today in Electrical Literature. If you intend to subscribe to it, do it now. One year, 50 cents; 2 years for $1.00, *3 years for* $1.50. *5 YEARS for* **$2.00.** (*Foreign postage to be added.*)

THE MACROPHONE OR LOUD SPEAKING TELEPHONE.

Loud talking telephones are always in great demand for various purposes, one use for them being illustrated in the sketch here presented, where piano music is transmitted electrically over a wire to a theater, or *vice versa*, etc.



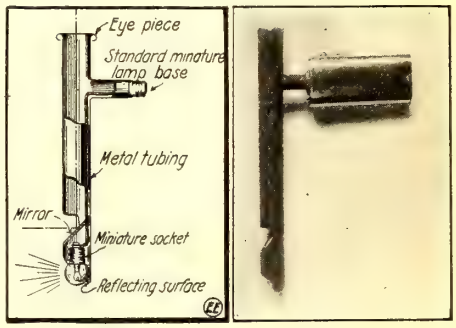
Loud Talking Telephonic Device Adapted to Piano Recitals, Etc.

The Macrophone loud speaking telephone is a radical departure from the usual form of such apparatus, as the diaphragm is composed of a thin wooden panel suitably supported in an acoustic sense. This wooden membrane is caused to vibrate and sets up sound waves by a powerful set of electromagnets acting on a lever secured to it. The lever is given resiliency by means of a strong rubber band, and thus no rigid connection exists between the diaphragm proper and its actuating magnets.

This loud speaker will transmit regular speech, music, phonograph sound, etc., and operates on eight dry cells, which will last for a period of three to four months. A microphone is generally used in the circuit, but for piano music transmission, such as shown here, the wooden diaphragm is rigidly connected to the piano sounding board by a wood pin glued between them. The Macrophone acts as transmitter or receiver.

AN ELECTRICAL INSPECTOSCOPE

A handy and neat instrument for inspectors, automobilists, engineers, machinists and others is the Crane inspectoscope, illustrated by the half-tone and detail sketch.

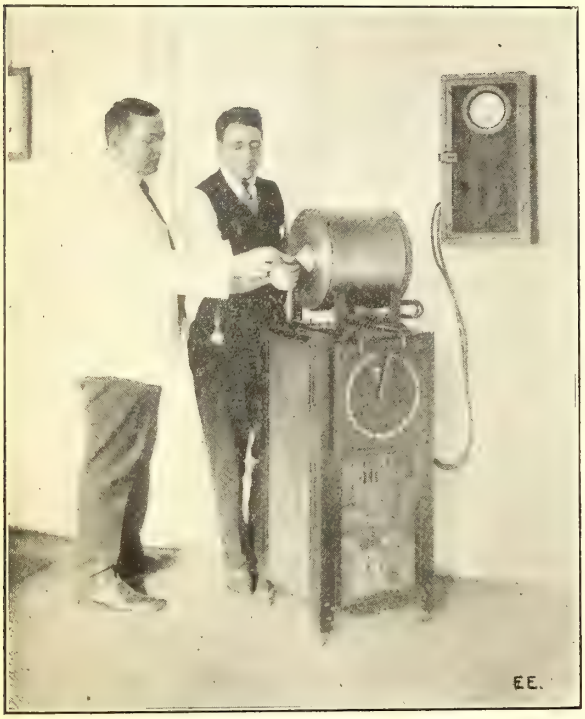


Sectional View and External Appearance of the "Inspectoscope," Useful for Looking Around Corners With.

It works on the principle of optical reflection, and, as the details indicate, use is made of a small flashlight lamp placed at the base of the tube. Hence in dark corners the lamp, which is lighted by screwing the attachment plug into any flashlight case, illuminates the object, and its image is viewed by placing the eye against the eyepiece at the top of the tube. The device is small in size and carried readily in the coat pocket. It is extremely useful in locating oil and carbon deposits in gas engine cylinders, small parts, screws carelessly dropped into some intricate machine, wires being 'fished" under flooring or in walls.

POWERFUL MAGNET DRAWS STEEL FROM BODY.

The removal of pieces of shrapnel, steel-jacketed bullets, steel shavings, etc., by the use of powerful electromagnets in hospitals abroad has been acclaimed by many newspapers as the very latest application of science to surgery. It is interesting to note that the Westinghouse Electric & Mfg. Co. has installed in the relief department of its East Pittsburgh Works a magnet for removing metal imbedded in the flesh, which is one of the most powerful in the world.



Powerful Electromagnet Draws Iron or Steel Chips From Fingers, Eyes, Etc.

The magnet is mounted on a box containing the resister, which is used to regulate the amount of current flowing through the coils. It requires 4,000 watts for its operation, or enough power to supply 100-32 C. P. Mazda lamps.

It is not an infrequent occurrence for steel and iron workers to get bits of metal in their eyes or hands. Previous to the installation of a magnet the only means of removal was by probing, a method which is as uncertain as it is painful. Since this electromagnet was put in operation it is a very simple proceeding to extract such particles. The portion of the body in which the foreign particle is embedded is placed near the pole tip of the magnet, the switch closed, and the magnet does the rest. The pole is removable, a number of different shapes being supplied for various classes of work.

It is very common for flying bits of metal to lodge in the eye. Should they strike with force enough to become imbedded the removal, without the aid of a powerful magnet, is apt to be difficult as well as painful. The protecting coating of the eye must be cut, and there is danger that instead of removing the particle it may be pushed further into the eye. When the foreign body is once within the eyeball it is properly a case for the specialist.

Steel workers frequently have their hands punctured with minute pieces of metal, which become imbedded under the calloused skin. If these bits are allowed to remain the wound is likely to become infected. The use of a powerful magnet insures the removal of all traces of iron from wounds in the hand or any other part of the body. Some remarkably small pieces have been extracted in this way, one recently recovered being not one-twelfth of the thickness of a delicate needle.

Dr. C. A. Lauffer, medical director of the Westinghouse company, relates a number of instances in which the magnet has proved invaluable. Among these is the rather amusing case of a workman who attempted to drill one of his own teeth. The drill broke off about half an inch from the end and remained in the cavity and it seemed as if the only way to remove the drill would be to pull the tooth. However, a special extension was made and fitted to the magnet pole. As soon as the extension was brought in contact with the drill and the current switched on the drill was immediately drawn out.

The American Telephone & Telegraph Co., and associated and connected companies are now giving service to 100,000,000 people by means of 90,000,000 telephones and 21,000,000 miles of wire.

The voice by telephone travels from New York to San Francisco in 1-15th of a second, traveling at the rate of 56,000 miles per second. The voice of a man speaking in New York is heard in San Francisco three hours earlier, that being the difference in the standard time of the two cities.

AMERICA'S VICE-PRESIDENT TRIES ELECTRIQUETTE.

By FELIX J. KOCH.

No, there are no heralds to proclaim, with sonorous: "Oh yez! Oh yez! Make way, * * * make way! The most excellent, the Vice-President of the United States"; but, instead, you hear the jingle of a little electric call-bell, then the soft whirr of rubber tires, and, lo, the Vice-President of the United States of America has gone by in an electriquette.

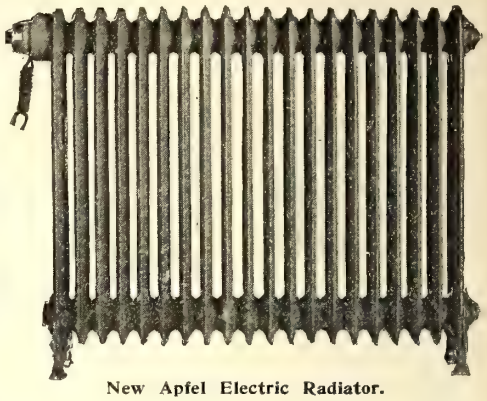
Of course, chances are, you do not know what an electriquette happens to be. Jack Roosa, who's been down to San Diego to see, tells us that it is a comfortable, two-seated sedan chair, fitted with much the same apparatus that drives an electric automobile. Only, it is simpler—so very much simpler that a mere child can operate it. So tired visitors to the big fair seat themselves in it, start on their journey and are soon whisked to where-so-ever they'd go; enjoying a much-needed rest mayhap the while.



Vice-President Marshall in an "Electriquette."

ELECTRICALLY HEATED RADIATOR.

A new electrically heated radiator has recently been put on the market. The heating elements are inserted through the bottom and top of the radiator. This element is divided into several sections and is connected to a multiple-pole switch which can either be attached directly to the radiator, as shown in the illustration, or placed at any convenient point desired. The consumption of energy based on a square foot of radiating surface is 30 watts to 35 watts on high heat, 15 watts on medium heat and 8 watts on low heat, giving a radiating temperature under normal weather conditions of approximately 200 deg. Fahr. on high heat. The amount of heat generated is controlled automatically by means of a thermostat.



New Apfel Electric Radiator.

A NON-MAGNETIC YACHT.

The "Carnegie," the yacht employed to make a magnetic survey of the earth, has just reached Honolulu after having passed through the Panama Canal. From there the staff will make magnetic observations in the South Pacific Ocean. These include the magnetic declination, the horizontal dip and the intensity of the magnetic field, together with studies of atmospheric electricity. The "Carnegie" is non-magnetic, being built of wood with locust spikes and copper sheathed below the water line. The auxiliary engine and all stoves are of copper; the 1,400-pound anchor is bronze; all metal fixtures are of non-magnetic material; all-brass lamps being used throughout.

FOR WOULD-BE CONTRIBUTORS.

If you've got a thought that's happy,
  Boil it down.
Make it short and crisp and snappy—
  Boil it down.
When your brain its coin has minted,
Down the page your pen has sprinted,
If you want your effort printed
  Boil it down.

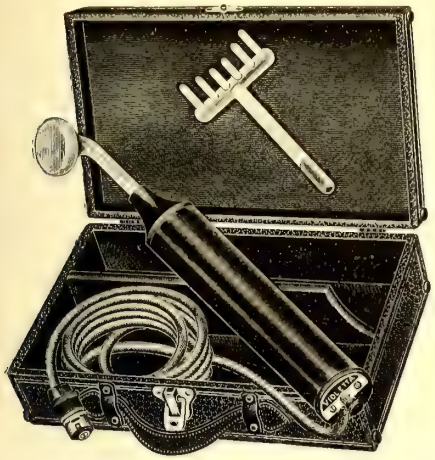
Take out every surplus letter—
  Boil it down.
Fewer syllables the better—
  Boil it down.
Make your meaning plain; express it
So we'll know, not merely guess it;
Then, my friend, ere you address it
  Boil it down.

Boil out all the extra trimmings—
  Boil it down.
Skim it well, then boil the skimmings—
  Boil it down.
When you're sure 'twould be a sin to
Cut another sentence in two,
Send it on, and we'll begin to
  Boil it down.

—*"Gumption."*

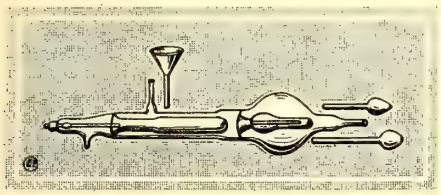
MINIATURE HIGH FREQUENCY SET.

One of the smallest practical high-frequency machines, and suitable for either direct or alternating current circuits, known as the *Violet'a*, is illustrated here-



Above: New Portable High Frequency Set Which Fits the Hand.

Below: Ozone Generator for Use With Set Above Shown.



with. This apparatus is so small it can be held in the hand while in use for generating high-frequency currents. The complete outfit, suitable for use by anyone, includes several treatment or application tubes exhausted to different vacua.

Owing to the special design of the vibrating interruptor on this device the action of same is very steady and uniform.

For those desiring to take ozone treatment a glass ozone generator is furnished at slight extra cost. It is seen in the illustration, and this instrument generates enormous quantities of ozone, which is purified by passing through a mixture of pine-needle oil and eucalyptus, and is injected into the lungs in the form of vapor by agitating the rubber bulb.

The treatment is very pleasant, and amazing results have been obtained, it is said. The ozone is driven directly into the lungs, where it is distributed throughout the body by the blood. In this way ozone inhalations not only have local effects but have excellent tonic and constitutional effects. For this reason ozone is so effective in cases of hay fever, which is the result not only of local irritations, but is also the result of lowered vitality.

Ozone also acts as a powerful germicide and disinfectant, destroying the toxin products of bacteria through its power as an oxidizing agent. Quick relief and results are stated as obtainable in cases of hay fever, asthma, rhinitis, nasal catarrh, colds, bronchitis, et cetera.

Time is electrically flashed from powerful lamps on top of the Metropolitan tower in New York City which can be read 25 miles away.

MARCONI RADIOTELEPHONY.

Mr. Marconi states that the Italian navy is using his wireless telephone system as a part of its system of intership and intersquadron communication. In some instances, he said, communication had been established between ships as far apart as 100 miles. At the present time, he added, his efforts were being directed toward the perfection of the invention for moderate and not long-distance communication. He confirmed the report, that the wireless telephone would probably be on the market in the United States within the present year.

"Our new stations at Belmar and New Brunswick, N. J.," said Mr. Marconi, "are out of commission and will probably remain so until the end of the war, because of the taking over by the British Government of the two corresponding stations in Great Britain. The British stations are being used in long distance work, some of the messages being to points as far distant as Egypt. Our station at Marion, Mass., which was built to communicate with Norway, is also out of commission, owing to the fact that Great Britain will not permit the exportation of the equipment and material necessary to complete the Norwegian terminal."

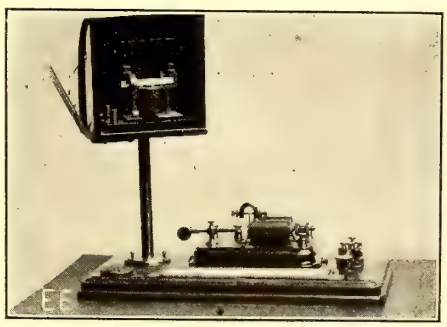
NAVAL WIRELESS IN JAMAICA.

Great Britain is erecting a powerful wireless station on the Blue Hills, near Kingston, Jamaica, according to latest reports. It is said the new station, which is 300 feet above the sea level, is intended to enable the Admiralty to send messages to the warships on the South Atlantic station.

Naval officers stationed at Kingston state that if such a plant had been in existence at the beginning of the war it would have prevented the defeat of Sir Christopher Cradock's fleet and enabled the warships on the coast to have picked up the Karlsruhe and the Dresden before they sank so many vessels.

TELEGRAPH SET THAT SIGNALED AROUND THE WORLD.

We present in the illustration shown a reproduction of the famous telegraph sounder, relay and key, as used a short time ago by Thomas A. Edison in sending the famous telegraph signal which circled the earth; repeating itself in the same office from which it had been sent



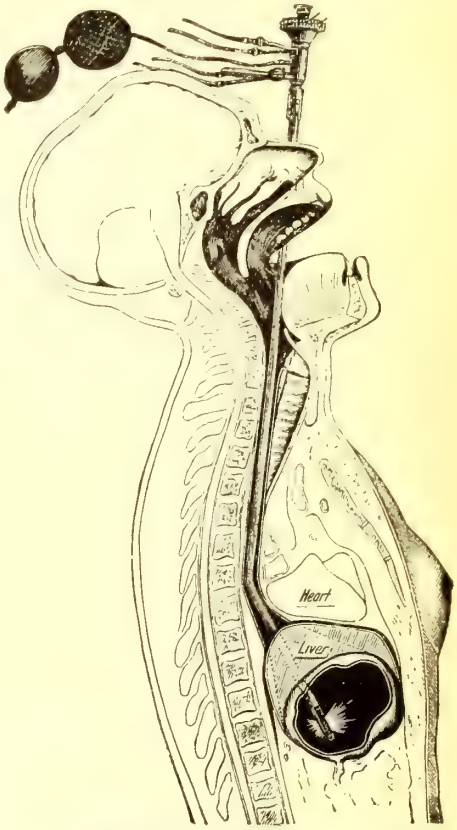
This Telegraph Set Signaled Through a 25,000 Mile Circuit.

out previously, but a few minutes before.

Of course, this was accomplished by relaying the message through several cable stations, in the globe-encircling journey. This apparatus is one of Uncle Sam's highly prized exhibits at Washington. Edison began his wonderful career as a telegraph operator, as have many of the present day leaders in industry and science.

ELECTRICAL ILLUMINATION OF THE STOMACH.

When the physician nowadays wants to find out what kind of a surface your stomach has he has other means at his disposal than the operating knife. Our illus-



How the Stomach Interior Can be Viewed by Using Small Electric Lamp and Suitable Jointed Tube.

tration shows how the perfected stomach lamp and periscope works. The metal tube of small calibre is passed through the patient's mouth and throat down into the stomach. By means of cleverly arranged reflecting mirrors in the tube the image is observed by the physician at the outer end of the tube. Rubber bulbs are shown attached for various requirements. Even surgical operations are performed through such tubes fitted with electric illumination.

MANY USES OF TUNGSTEN.

Tungsten is used principally as an alloy of high-speed steel—that is, steel used in making tools used in metal-turning lathes running at high speed—to which it imparts the property of holding temper at higher temperature than carbon steels will. The now well-known ductile tungsten is used for incandescent lamps, which are fast replacing carbon lamps. Recently greatly improved lamps, in which the wire is wound in helices and in which the globes are filled with nitrogen, have produced a close approach to white light. These lamps are furnished in candlepowers up to 2,000. Ductile tungsten is practically insoluble in all the common acids; its melting point is higher than that of any other metal, its tensile strength exceeds that of iron and nickel, it is paramagnetic, it can be drawn to smaller sizes than any other metal (0.0002 inch in diameter) and its specific gravity is 70 per cent. higher than that of lead.

If you are not a subscriber don't fail to read announcement on page 95.

New Lamp Signals on Pennsylvania R. R.

AN entirely novel signal system, differing in all respects from any ever before used by any railroad, was recently placed in operation by the Pennsylvania Railroad from Overbrook to Bryn Mawr, Pa. This is a portion of the section of the main line between Broad Street Station, Philadelphia, and Paoli, Pa., now being electrified.

The new signals are especially designed to promote safety, efficiency and economy. All moving parts are eliminated from the signal apparatus. This not only reduces to a minimum the chance of getting out of order, but is also expected to lessen the cost of installation and maintenance.

The same signals will be used both day and night. Enginemen will therefore be guided by the same code every hour of the twenty-four, with corresponding reduction of the chance of error. Necessity for distinguishing between lights of different colors is banished by using only white lights.

The feature of the new signals is the substitution, for day and night use alike, of brilliant white electric lights, showing sharply against a black background in place of the moving arms of the semaphore, now used by day, and the colored lights used at night.

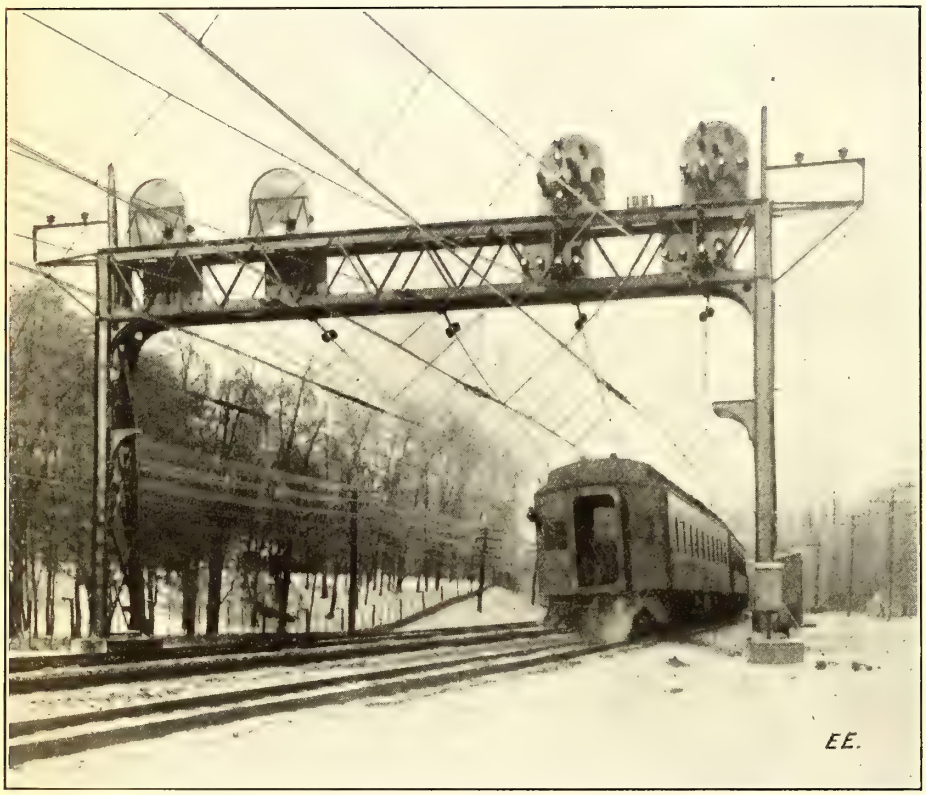
All positions of the semaphore arms—horizontal, diagonal and vertical—are duplicated in the new signals by the rows of electric lights. Each signal has a sufficient number of rows of lights to be the equivalent of two semaphore arms.

To make the lights clearly visible, even in the brightest sunlight, the voltage used in the daytime will be nearly quadruple that used at night. The lamps can easily be seen in the clearest sunshine for more than 4,000 feet.

So powerful are the lamps that when the full current is used at night it is possible to read large type by their light at a distance of 1,000 feet.

Each signal will protect a block of track 3,500 feet in length. A train passing a signal will automatically set it at "stop." When the train reaches the next block the first signal will change to "caution." Another position of lights will show when two full blocks are clear and a fourth position when three or more are unoccupied.

An engineman will always receive notice of a possible stop at least 7,000 feet in advance, and will receive two cautionary signals before approaching the "stop" signal.



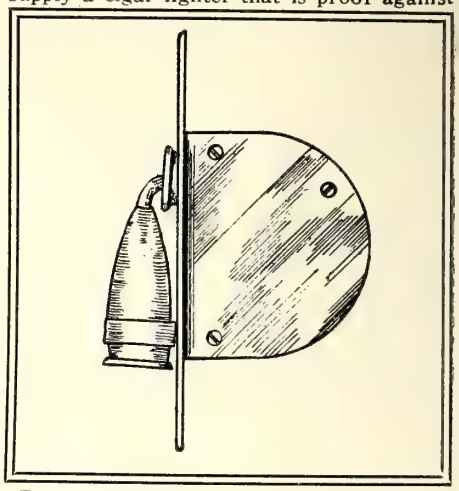
Latest Railroad Signal Employs Powerful Electric Bulbs Instead of Semaphore Arms. Lamps Can be Seen 4,000 Feet Even in Bright Sunshine.

INTERRUPTIONS IN RADIO TRANSMISSION FROM GERMANY.

The Nauen-Sayville and Hanover-Tuckerton transatlantic wireless systems, which have been transmitting the bulk of telegraph traffic between the United States and Germany since the cutting of the Emden cable, have for the past few weeks suffered severe service interruptions. Although the plants have been found to be sufficiently powerful to interchange messages, even by daylight, during the winter season, with the coming of warmer weather (and the accompanying increase of "static") communication has become impossible for a large part of each day. The Sayville transmitter is being enlarged so as to improve sending to Germany, but this will of course not aid reception in the United States. Many combinations of receiving apparatus are being tried both at Tuckerton and Sayville, in the hope of eliminating "static" interference to such a degree as to permit the German signals to be read. It is not known whether or not there will be any attempt to increase the sending power of the Nauen or Hanover station.

WINDPROOF ELECTRIC CIGAR LIGHTER.

Every smoker has experienced the difficulty of lighting a cigar or cigarette in a moving automobile or motor boat. A match is blown out instantly and even a pocket cigar lighter is extinguished by the wind. To supply a cigar lighter that is proof against the strongest wind and that works automatically is the object of a little electrical device that caused much interest at the recent Automobile Show.

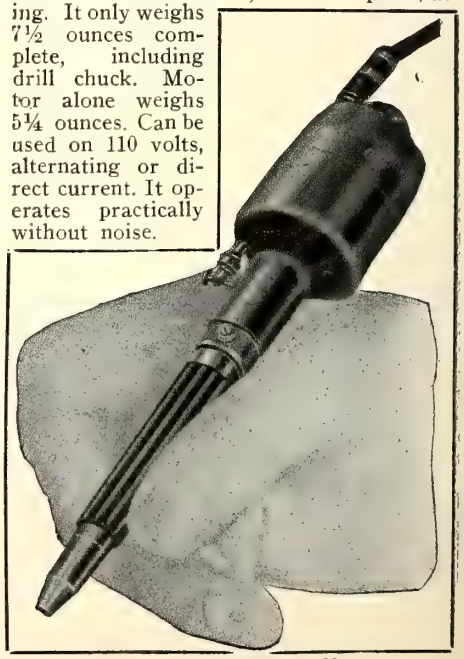


Electric Cigar Lighter Which is Windproof.

It consists of a little knob hanging from a cord. This is attached to the most convenient part of the woodwork and takes up scarcely more room than an ordinary push button. When one wants a light he simply pulls out the knob and the end instantly glows with sufficient heat to light cigar or cigarette, the cord being of sufficient length to enable one to get a light without changing position. On releasing the lighter the cord is automatically rewound and the current automatically disconnected. The lighters are attached to the dynamo lighting circuit or batteries and are made for any voltage.

ELECTRIC MOTOR FITS THE HAND.

An extremely small electric motor is here shown, which is intended for dental drills and other work, such as perforating. It only weighs 7½ ounces complete, including drill chuck. Motor alone weighs 5¼ ounces. Can be used on 110 volts, alternating or direct current. It operates practically without noise.



Electric Motor Fits the Hand.

Many other uses for this extremely neat motor will suggest themselves to the reader.

How to Build a Photophone

By Homer Vanderbilt

DR. ALEXANDER GRAHAM BELL, the inventor of the electric telephone, was the first to succeed in transmitting sound without the aid of any wire connection, although this method is not practical, but is interesting and valuable to many experimenters. His method of transmitting speech without wires will be described herewith, and details of constructing a simple photophone will be given.

This instrument will work very well for distances up to 900 feet. Dr. Ruhmer, the German scientist, has made photophones that have worked many miles. The photophone herein described was built by the writer, who has used it successfully for demonstration and experimental purposes.

Referring to the details, the transmitter is indicated at Fig. 1, and the circular transmitter head A is made from soft wood, turned out in a lathe, to the shape shown. Any wood turner will turn it out for a small sum. The diafram B is an ordinary tin one from a telephone receiver, and one side is nickel plated and highly polished; the reason for this will be explained later. The diafram is fastened to the head A by means of four small brass screws, or better, by a circular ring of wood. The supporter C is made from soft wood 10"x6"x1"; the base D measures 8"x7"x1½", and it is also made from the same material. Two small brackets are now fastened on each side of the supporter C, as shown. Next fasten the transmitter head on to the frame; this is done with two flat-head brass screws. The mouthpiece E is the ordinary telephone transmitter mouthpiece and can be readily obtained in any electrical supply house.

The receiving instruments are now to be considered. They consist of a parobolic reflector A, selenium cell K, battery B, telephone receiver R, and supporting frame for the parabolic reflector and selenium cell. The reflector is purchasable at small cost or can be made from a tin, copper or aluminum bowl. The bowl should not be larger than 12 inches in diameter. A small piece of wood B is made to support the cell K, and is held in place by means of three screws I, I, I, which are placed through three holes made in the bowl.

The supporting frame C and base D are made the same as for the transmitter, with the exception that C is one inch longer, as may be seen in drawing. A small wood shelf F is added, which can be 4"x8", etc. It is strengthened by means of a bracket G. The parabolic reflector is next mounted in place. It is supported by means of an 8-32 screw E.

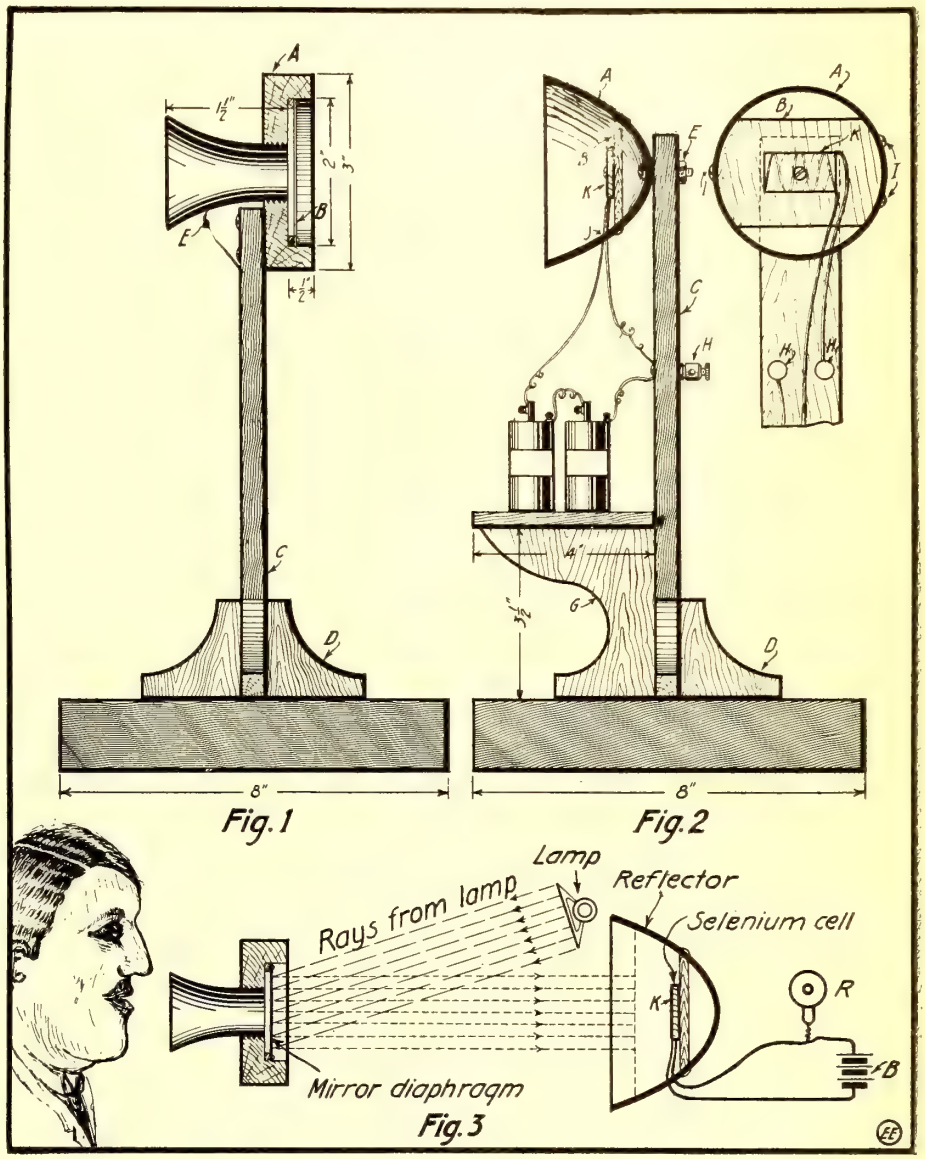
We now come to the most difficult part of the whole apparatus, and that is the selenium cell. This can be either purchased from any reliable concern or else made. A very easily constructed selenium cell was described in the August, 1914, *Electrical Experimenter,* and no further explanation is necessary here.

The selenium cell is placed on the plate B and fastened to it by two screws. Care should be taken not to tighten the screws too tight or the selenium will crack, which makes the cell worthless. The two terminals of the cell are brought through the hole J and one of the them is connected to one binding post H, while the other one is connected to two or three batteries, which are placed on the shelf F. The other terminal of the battery B is connected to the second binding post H¹, and a telephone receiver R is connected across these binding posts.

The apparatus is now completed and ready to receive a good coat of heavy orange shellac. To operate this photophone it is necessary to place both transmitter and receiver at right angles to each other and an ordinary carbide bicycle lamp is placed in such a manner that all the rays of light fall on the polished transmitting diafram B and are thus reflected onto the parabolic reflector A, Fig. 2. A good idea of how to arrange the apparatus is shown in Fig. 3. The writer advises the builder of this photophone to use it for short distances at first, until he familiarizes himself with the working parts of the apparatus. By using a larger source of light, such as an arc lamp, the distance may be considerably increased, of course.

For those who are not familiar with the principle upon which this instrument works, the writer has endeavored to show how this valuable and interesting apparatus operates. By referring to diagram 3, the receiver and battery are connected in series, the battery current is caused to vary and in this way causes the diafram of the receiver to vibrate according to the variation of current. Thus sound is transmitted exactly as spoken into the transmitter.

It is hoped that this short article on the photophone will interest many readers, who are interested in scientific research, as a great deal of experimental work may be performed on photophones. This apparatus may be advantageously used by Boy Scouts for signaling purposes, etc.

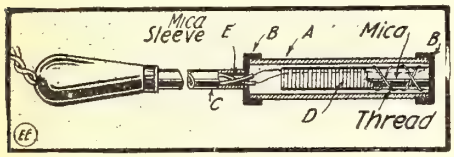


The Photophone Which Transmits Speech by Beam of Light.

Transcontinental telephone talk is made possible to a large extent by the De Forest audion amplifier.

AN ELECTRIC IMMERSION HEATER.

The first thing to be made for this useful form of heater is a one-inch pipe nipple A, 4 inches long, and two caps, B, B. In one of these caps drill a 5/16-inch hole and tap for ⅜-inch pipe. A ⅜-inch nipple C, about 3 inches long, is next inserted into this thread. Care should be taken to see



Simple Electric Immersion Heater.

that this case and nipple C is made watertight. This is facilitated by placing white lead on the threads.

The heating element is wound on a ⅞-inch porcelain tube D. Now wind 20 feet of No. 24 nichrome resistance wire on it, and each turn should be separated from its neighboring turn, so that they will not short-circuit each other. Lead about two feet of wire through the short nipple C. Splice on to these leads some lamp cord, or better yet, use asbestos insulated heater cord. Make the splice by twisting the wires together and insulate them with a winding of asbestos string. Try 110 volts across these leads. The element should heat up to a dull red, if not use less turns of wire. Get some thin sheets of mica and wrap them around the element, covering all exposed wire. Tie the mica on with some thread. This will hold it until placed in the case, when the thread will burn off, leaving the element insulated from the nipple by the mica. A mica sleeve E is next made and inserted in the nipple C. It is used to insulate the lead wires from the case. Turn up a short wooden handle of any desired shape and drill a hole through it. Lead the lamp cord through this hole and force the handle into the nipple. Test carefully to see that there are no *grounds* to the case. An attachment plug on the cord completes the heater. Be careful in using it, that it is always immersed, while the current is on, else it will soon burn out. The drawing shows the arrangements of the various parts.

INVISIBLE INK RECIPES.

I am sending you some formulæ for invisible ink, for which I think the experimenter may find much use on various occasions.

Recipe No. 1.—Writing fluid: 1 drachm potassium iodide; enough water to make 1 ounce. Reagent: A strong solution of bichloride of mercury; apply with a brush and the writing will come out red.

Recipe No. 2.—Writing fluid: 1 drachm potassium ferrocyanide; enough water to make 1 ounce. Reagent: 1 drachm perchloride; enough water to make 1 ounce, or 50 per cent. solution of tincture of iron; apply with a brush and the writing will come out blue.

Recipe No. 3.—Writing fluid: 1 drachm cobalt chloride; enough water to make 1 ounce. Reagent: Heat, and the writing will be blue.

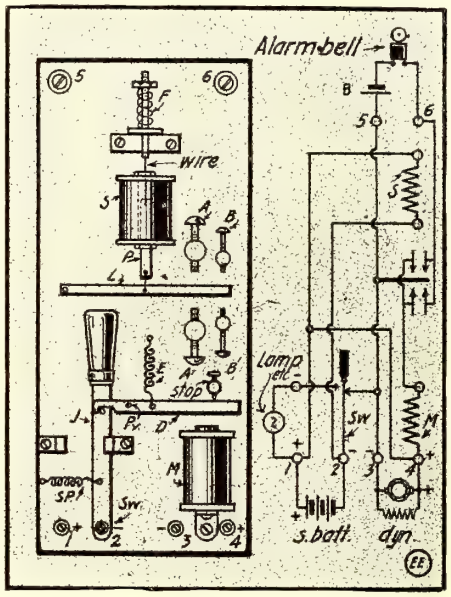
A small amount of acacia gum added to the writing fluids will improve the writing quality. I prefer the number one because it is easier to get, the paper is unstained and the writing can be erased by simply heating. I will be pleased to hear from any one who tries these formulæ.

Contributed by K. K. KNAELL.

AUTOMATIC BATTERY CHARGING BOARD.

The following is a description and illustration of a simple switchboard designed to call the operator's attention when the storage cells are fully charged or need charging. When the cells are charged to capacity the combined switch and circuit breaker shown on the lower half of the board cuts out the charging circuit, also rings a bell or similar alarm. When cells are discharged to a point consistent with safety the alarm again rings, indicating that the cells need charging.

Referring to the drawing, S is a solenoid wound with fine wire to a resistance of 120 ohms for a six-volt charging circuit. With higher voltages the ohmage of the solenoid must be increased proportionately. P is a soft iron plunger loosely suspended in the solenoid. At F is a spring and nut for adjusting the plunger, which moves *freely* in the solenoid. L is a brass bar, pivoted and connected to plunger P. A and A′ are adjustable contacts. B and B′ are also contacts similar to A and A′, but smaller. M is a strong electro-magnet wound with *large*



Clever Battery Charging Panel.

wire (No. 18 or No. 16) to resistance of *two* ohms. D is an iron armature lever shaped as shown, pivoted at PV, its end being a sort of trigger, engaging a pin attached to switch SW. SP is a rather strong spring to pull out switch blade, when released at J, over to switch contact on left.

The plunger P is made such a length as to enter less than half way into the brass solenoid tube. The plunger is drawn into the core in proportion to the rise in voltage, and released when the voltage decreases or falls. It is, in principle, a voltmeter.

Referring to wiring diagram, positive generator lead is connected to terminal 4; negative lead connects to 3. Positive storage-battery lead is connected to binding post 1 and the negative lead connects to binding post 2. Posts 5 and 6 connect to bell or other alarm in series with dry cell.

When wiring is finished and dynamo and storage cells connected to their binding posts, see that switch is in vertical position shown in sketch.

Commence charging until cells are fully charged. When this occurs, adjust contact A until it touches L. Do the same with B. This done, the magnet M attracts D, releasing switch, which is pulled to left-hand switch point by spring SP. Alarm will ring also. E is a small spring to hold the armature lever in horizontal position.

Now discharge battery to a point consistent with safety (about 1.78 volts per *cell*). Then adjust contacts A′ and B′ until bell rings. The board is now ready for steady work, requiring no attention other than throwing switch to right-hand switch point when charging.

If the dynamo is driven by an electric motor which is in series with a circuit breaker, by connecting the circuit-breaker magnet in series with the circuit-breaker magnet of the switchboard the dynamo will stop automatically when cells are fully charged.

The switch parts, binding posts, contacts, also the solenoid and magnet, which are wound to order, can be supplied by any electrical house if you don't want to make them. Contributed by

CLARENCE W. GALLINGER.

STRONG MAGNETIC FIELDS.

An electro magnet constructed by Deslandres and Perot and described in a communication to the French Physical Society last year produced a magnetic field of 41,000 gausses in an air gap 2.1 millimeters long and 3 millimeters in diameter, with pole pieces of iron. The exciting current was 24 amperes in this case. The maximum field obtained was 51,500 gausses, utilizing 30,800 ampere turns.

With special pole pieces of cobalt steel a field of 50,500 gausses was produced in an air gap 1.7 millimeters long and 3 millimeters in diameter.

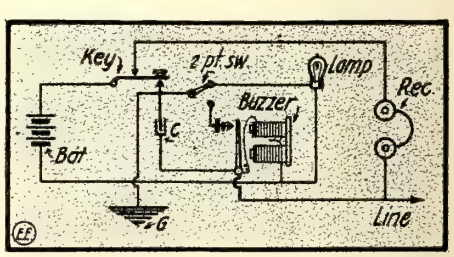
U. S. SIGNAL CORPS BUZZER TELEGRAPH.

The telegraph signaling system employed in the United States Signal Corps branch of the army is very ingenious and, as is generally known, will operate under very poor electrical conditions, as when the wire may be cut in one or more places, etc.

We show herewith diagram of connection as used in these field type, buzzer telegraph sets, and the signals are received at either station by means of head 'phones shown.

Closing the key at either instrument operates the buzzer, which creates a series of rapidly interrupted electrical impulses, having several times the voltage given by the battery owing to the high self-induction of the buzzer magnets.

This set is also arranged with a switch in some cases, so that at night the set may be utilized for flashing signals by means of a battery lamp, indicated on drawing. In this case, of course, no line wire or



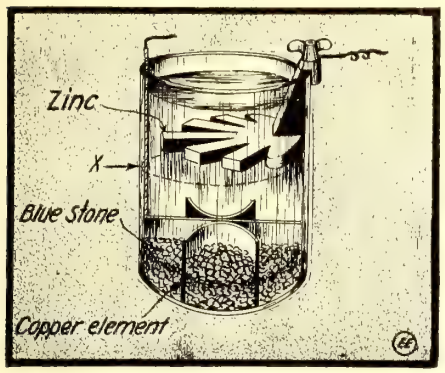
U. S. Signal Corps Buzzer Telegraph.

ground connection is necessary and the signals are observed from at a distance by means of field glasses, etc., the short and long signals of the telegraphic code being produced by giving long and short flashes of light in the battery lamp.

It may be remarked that a small condenser is usually hooked across the buzzer contracts in order to reduce sparking.

HOW TO CONSTRUCT A GRAVITY BATTERY.

To set up a gravity battery use about 3½ pounds of bluestone, or enough to cover the copper element 1 inch. Pour in water



Making a Gravity Battery.

sufficient to cover the zinc one-half (½) inch, short circuit for three hours and the battery is ready for use. If desired for use immediately do not short circuit, but add five or six ounces of "zinc sulphate."

Keep the dividing line X between the blue and white solutions about one-half inch below the bottom of the zinc. If too low, siphon off some of the white liquid and add the same amount of water, but do not agitate or mix the two solutions.

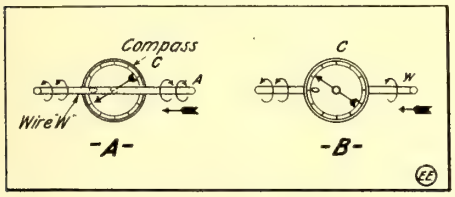
This type of battery will give about 0.9 of a volt, but only a fraction of an ampere. It is used for burglar alarm and closed circuit telegraph work very extensively.

Many amateur electricians and some professionals have undoubtedly had considerable trouble with gravity batteries. They follow directions carefully and then fail to get good results. The usual trouble is not with the battery itself, but with the circuit. A gravity battery is suitable only for a circuit which is normally closed. It is therefore undesirable for "electric bells," "induction coils" and all other open circuit apparatus requiring fairly strong current. The circuit should also have a high resistance. This makes it impractical for running fan motors, as the motor would have to be wound with fine wire. And it would then require a large number of batteries to give a sufficiently high voltage.

Contributed by W. JOHN GWINN.

DETERMINING DIRECTION OF AN ELECTRIC CURRENT.

If the current in a wire is flowing from south to north and a compass is placed under the conductor, the north end of the needle will be deflected to the west, as



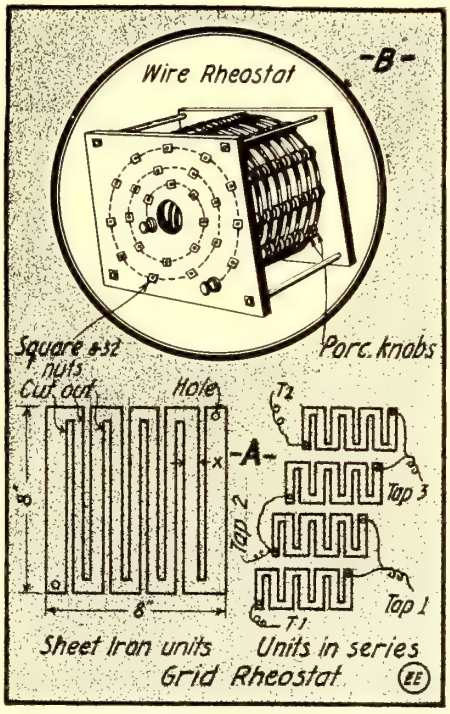
How the Compass Acts When Placed Under and Above a Live Electrical Conductor.

shown at A in sketch. If the compass is placed over the conductor, the north end of the needle will be deflected to the east, as shown at B. The compass needle should be placed parallel with the wire first. Even the current from a dry cell passing through a conductor to a bell, etc., will deflect the compass. This is the basic principle on which the galvanometer is built.

CONSTRUCTING RHEOSTATS.

Rheostats or resistance boxes are often required in electrical work, and a few types are illustrated here which the practical man will find of interest. At Fig. A is shown how ordinary iron sheet, or German silver sheeting, can be cut to resemble the grid resistances employed commercially for controlling motors, and so on.

The number of sheets used and the width of the strip X, as well as its thickness and length, are, of course, dependent upon the current required to be carried, as also the voltage drop to be effected. The physical properties of sheet metal are to be found in any handbook on electricity. It is easy to figure out the resistance required for a given load. It is equal to the volts drop required divided by the current in amperes to be used. Say, for instance, that 40 volts drop is wanted and a current of five amperes. Then the resistance of the whole rheostat must be five into 40 or eight ohms. The various grid plates can be connected in series or on parallel as desired. The total resistance of a series rheostat will be that of



Rheostat Construction and Details of Same.

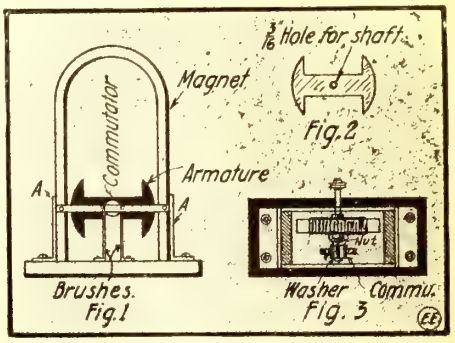
one grid multiplied by the number of grids. On parallel the total resistance will be that of one grid divided by the number of grids. The arrangement of grids in series is indicated.

A compact and cheap form of rheostat used for arc lamp ballast, etc., is the cylindrical type shown at Fig. B. Several layers of wire are used in a small space in this unique design. The turns are wound on small grooved porcelain knobs, placed on a series of 8-32-inch metal rods, threaded at both ends, and secured in place between two metal end discs by hexagon or square 8-32 nuts. Tap leads can be brought out, of course, as desired from any layers or parts of layers to switch points.

When a storage battery is only partially discharged it requires only a partial charge. Charging a battery that is already full is not only a waste of current, but it is injurious to the battery, and care should be taken to cut off the current as soon as the maximum charge is attained.

HOW TO MAKE A SMALL ELECTRIC MOTOR.

A small electric motor can be readily made from odd parts by any experimenter. The magnetic field is supplied by a permanent magnet of the horse shoe type, as perceived. The armature consists of eight or



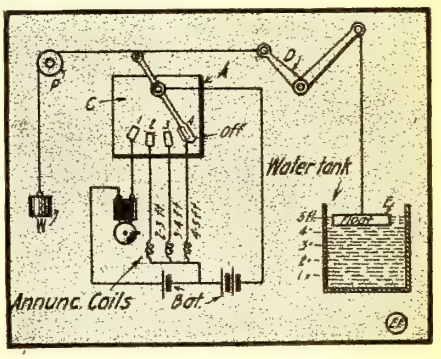
Electric Motor Which is Easily Made.

10 pieces of soft iron, cut as shown in Fig. 2, and made from No. 27 soft sheet iron, or tin will do. The armature sheets are kept in place on the shaft by two nuts which are tightened up firmly on either side or they may be soldered in place. The bearings are made of heavy sheet brass with a 3/16-inch hole on each end and one in the center, to take the shaft. Next arrange bearing support A A, of brass.

The stand consists of four, or better, one piece of brass, screwed to the base on each side of the magnet. A 3/16-inch shaft threaded at the center carries the commutator and armature. The commutator is made from a wooden cylinder ½ inch in diameter and ½ inch long, and it is secured on the shaft by forced fit. The wooden cylinder is now covered with some heavy tin foil, which must be securely glued on and afterwards cut into two pieces, to make the two segments as shown in Fig. 3. Now wind the armature core with seven or eight layers of No. 24 insulated magnet wire and carefully fasten the ends to the two commutator segments by small nails or screws. Two short pieces of sheet brass for brushes are next bent, as shown in Fig. 1, and are secured to the base by means of two brass screws. These strips act as brushes and should touch the commutator very lightly, but at the same time making good contact with the commutator.

A WATER-LEVEL SAFETY ALARM.

A very simple water-level safety alarm can be readily rigged up by following the instructions and drawing given herewith.



Simple Water-Level Alarm.

At first construct a trip switch A shown in drawing, which consists of brass contacts 1, 2, 3, 4, and a lever B mounted on a suitable base C. Next construct the lever arm A with its float E. After these parts are completed mount them on a wooden

(*Continued on page* 102.)

WRINKLES—RECIPES—FORMULAS

Edited by S. GERNSBACK

Under this heading we will publish every month useful information in Mechanics, Electricity and Chemistry. We shall be pleased, of course, to have our readers send us any recipes, formulas, wrinkles, new ideas, etc., useful to the experimenter, which will be duly paid for, upon publication, if acceptable.

FORMULA No. 11.
Photographic Baths.
(DEVELOPERS).

Eikonogen Developers.—No. 1. 20 oz. *Distilled Water,* 2 oz. of *Sulphite of Soda* (cryst.), ½ oz. of *Eikonogen Crystal.* No. 2. 20 oz. *Distilled Water,* ¾ oz. *Carbonate of Potash.* Mix No. 1 and 2 in equal parts, and to each ounce add 2 to 4 drops 10 per cent. solution *Bromide of Sodium.*

Hydrochinon Developer.—No. 1. 10 oz. *Distilled Water,* 2 oz. of *Sulphite of Sodium* in cryst. chem. pure, 1 oz of *Hydrochinon.* Dissolve and keep in a yellow bottle. No. 2. 10 oz. of *Distilled Water,* 2 oz. of *Carbonate of Potash,* 1 oz. of *Carbonate of Soda.* Mix 2 drm. of No. 1 and 1½ drm. of No. 2, then add 3 oz. of *Water* (dist.).

Combined Hydrochinon and Eikonogen Developers.—No. 1. 60 parts of *Sulphite of soda* (cryst.), 40 parts of *Crystal Soda,* 1,000 parts of *Distilled Water.* After solution filter. No. 2. 50 parts of *Eikonogen,* 50 parts of *Hydrochinon.* Place together in a mortar, grind down to fine powder and keep dry in well stoppered glass bottle. For use take one part of No. 2 and dissolve it in 100 parts of No. 1. This developer is one of the best known; it possesses all the advantages of the other developers, without their disadvantages.

Iron Developer.—No. 1. 120 gr. of *Citric Acid,* 88 gr. of *Carbonate of Ammonia,* 1 oz. of *Distilled Water.* No. 2. 140 gr. of *Sulphate of Iron,* 1 drop of *Sulphuric Acid,* 1 oz. of *Distilled Water.* To 3 parts of No. 1 add 1 part of No. 2.

Ferrous Citro-Oxalate Developer.—No. 1. 1 oz. of *Neutral Oxalate of Potash,* 2½ oz. of *Bromide of Potassium,* 5 oz. of *Hot Distilled Water.* No. 2. 2 drm. of pure *Proto-Sulphate of Iron,* 2 oz. of hot *Distilled Water.* Mix together 2 parts of No. 1 and 1 part of No. 2.

Pyro Developer.—Dissolve and keep in tight fitting stoppered bottles. No. 1. 50 grn. of *Pyrogallic Acid,* 150 gr. of *Sodium Sulphite,* 10 gr. of *Citric Acid,* 1 oz. of *Distilled Water.* No. 2. 50 gr. of *Potassium Bromide,* 1 oz. of *Water.* No. 3. 2 drm. of *Ammonia* (0.880), 2¼ oz. of *Distilled Water.* Take 1 part of each and mix.

Tintypes Developer.—1 oz. of *Distilled Water,* 14 grn. of *Sulphate Iron,* 10 gr. of *Saltpeter,* 30 min. of *Acetic Acid,* 2 min. of *Nitric Acid.* S. G.

NEW INVENTIONS IN PHOTO-PLAYS.

(*Continued from page* 86.)

for many years, which consists of making the suspected thief or criminal hold some rice in his mouth. The suspected persons are lined up in court and sentence pronounced; afterwards the rice from each one of their mouths is removed and examined by experts. The one from whose mouth the rice shows no moisture is invariably the guilty one; as it is claimed that although their faces may not show any change of emotion when they are guilty there is an inward muscular and nerve action taking place which causes the saliva to be checked and thus the mouth remains dry.

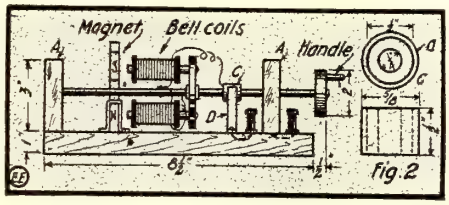
AN ELECTRIC TICKLER.

A very simple but amusing little machine can be made by anyone who is familiar with the handling of common tools. The following material will be necessary in order to construct this little alternating-current dynamo. Two electro-magnets, taken from an old electric bell; a 5-inch horseshoe steel magnet; two brass standards, A A, 3x½x½ inch; 4 inches of ¼-inch round brass rod; ½ inch of ½-inch diameter round rubber rod; also a wooden base 8½x5x1 inch, two binding posts and brass wood screws.

At first mount the steel magnet in an upright position by means of a brass strip as shown. Next construct the armature, which consists of two electro-magnets mounted on ¼-inch brass shaft. Upon this shaft mount a collector ring C, which is made from hard-rubber rod, shown in Fig. 2. A brass cylinder (a) is then put on the rubber rod.

The shaft is supported by means of two brass standards as shown. One terminal of the electro-magnets is soldered to the shaft, while the other terminal is soldered to the ring C. A brass spring D is next placed on the base so that it will touch the ring C as shown. A small handle and disc are next made and placed upon the shaft.

Connections are made from one standard and from the brass spring D to the two binding posts. By turning the crank handle and holding two conductors, which are



Two Rotating Magnet Coils Make this Electrical Tickler or Shocker.

connected to standard and spring, a shock is obtained. By turning the electro-magnets faster or slower the strength of the shock is varied in proportion. This is the principle of large dynamos, and the first electro-medical machines made by Kidder and others were similarly designed. A couple of tin handles about ¾x4 inches serve very well.

OUR NEXT NUMBER

Will have as a special supplement a large picture of

MARCONI

suitable for framing. This will make an ideal portrait for your den or home. There will also be many new features in the August issue. Be sure to order your copy now.

A WATER-LEVEL ALARM.

(*Continued from page* 101.)

base. The pulley P is placed on left-hand side of the base as shown. An electric annunciator is connected to three of the plugs of the switch A, and the last contact is made with a bell. The connections are shown in the drawing. Now if the amount of water decreases the float will sink, and as soon as the level is below the 4-foot line the switch arm will make contact with the next contact piece and the annunciator will show its 3-4 feet drop. Next will come 2-3 feet, and then, when the float has sunk below the 2-foot line, the arm will come upon the last contact and the alarm bell will ring, notifying the engineer that the tank is nearly empty.

BOOK REVIEW.

"Elementary Electricity and Magnetism." By William S. Franklin and Barry MacNutt, 174 pages, 153 illustrations. Cloth, 7½x5 inches. Leather back. The Macmillan Co., New York. Price, $1.25.

This book is rather refreshing in a way, considering the method used in explaining the elements of electrical units, circuits, magnetism, etc. Practical aspects of the action taking place in electrical and magnetic circuits are explained in a very logical way with the aid of special diagrams. It is a good book for students of all classes and really gives a thorough understanding of the electro-physical action occurring. The heating and chemical effect of electricity is explained with simple formulæ, so that anyone can understand them.

A particularly interesting section deals in an excellent and new manner with the "electric charge and the condenser." This section explains such vitally interesting things also as "spark discharge and corona," "electrical precipitation of smoke and dust," etc.

"A School Electricity." By C. J. L. Wagstaff, M.A. 250 pages and 136 illustrations. Green cloth, 9x6 inches. G. P. Putnam's Sons, New York. Price, $1.50.

Mr. Wagstaff has presented his treatment of electricity and magnetism in a rather new way, so to speak. The magnetic field of force is thoroughly covered and some new curves and figures of the magnetic flux field around different magnets and circuits are presented. This is a good book for the student and will undoubtedly give him a very keen perception of the laws of magnetism and electric currents.

Each chapter has a number of questions at the end of same, and numerous practical experiments are described. All teachers of electrical subjects would do well to look over this work. About a dozen fine plates appear at the end, showing clearly how the magnetic flux appears in the field of various magnet poles.

"The Boy Electrician." By Alfred Powell Morgan. 394 pages, 324 illustrations. Cloth. 8vo. Price, $2.00. The Lothrop, Lee & Shepard Co., Boston, Mass.

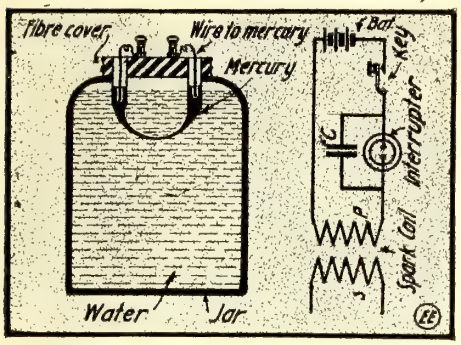
A new and extremely practical book for the boy and young man is this latest work of nearly 400 pages from the pen of Mr. Morgan. Every kind of intrument imaginable is described in attractive style, with excellent working drawings to guide the builder of same. A good feature is that which incorporates half-tone or photographic views of the various completed apparatus so that the reader will be sure to understand just how each instrument looks when finished. Wireless apparatus as well as high-frequency coils for demonstration, etc., are clearly described.

BIRD CROSSES WIRES.

Recently mention was made of a cross on a line in California caused by a snake, says *Telegraph and Telephone Age.* Now J. L. Henritzy, superintendent of telegraph of the Colorado & Southern Railway, Denver, Col., writes that one of his linemen cleared a cross by removing a Chinese pheasant, whose neck was in the twist of two wires. As the bird had not been dead over an hour, it made a toothsome morsel for the table, besides supplying beautiful long tail plumes.

UNIQUE SPARK COIL INTERRUPTER.

Here is a description of a really practical interrupter which gives perfect satisfaction on coils up to 3-inch spark. With



Unique Mercury Interrupter for Small Coils.

this interrupter sticking contacts, etc., are unknown.

To construct the apparatus, secure a two-pint "Mason" fruit jar and cut from fiber a cover to fit. Bend and draw out a glass tube as shown, making the hole in the middle of the bend almost as small as that in a thermometer tube. Bore two holes through the fiber cover and fit the arms of the glass tube tightly into them. Mount two binding posts on the fiber top and connect short pieces of No. 14 copper wire to them as shown.

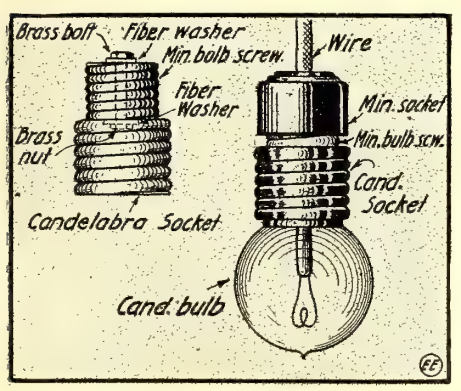
To operate, fill the jar with water to the level shown, and the bent glass tube with mercury to about the same level. Experiment will show the exact height to which the tube must be filled. Now connect the interrupter in series with the spark-coil primary, key and battery, having previously removed the hammer interrupter or bridged it across with wire. As soon as the current is switched on a bright green spark will appear in the tube.

The water in the jar serves to carry off the heat generated. The interruptions are of a higher frequency than those obtained with a vibrator and are steadier. This interrupter was invented by Mr. H. Gernsback in 1904. Contributed by

JAMES L. GREEN.

MAKING CANDELABRA BASE LAMPS FIT MINIATURE SOCKETS.

Secure an old burned-out miniature bulb; break the glass and scrape the plaster of paris out. Take the fiber washer out



How to Use Candelabra Base Lamps in Miniature Sockets.

and put it on the other side; then put the bolt through. Then place the candelabra socket on and put a fiber washer in it. Clamp the nut and screw up tight. If when screwed in a miniature base it refuses to work, melt a drop of solder and put it on the head of the bolt, but be sure the bolt is well insulated from the brass socket. Then screw it on a miniature socket and put in your candelabra bulb. Contributed by ALBERT PETTY.

BEDSPRING AERIALS.

I find that when using small radio receiving sets that they work better by using a steel woven wire mesh bedspring for an aerial than an indoor aerial consisting of five strands of copper wire, 1 foot apart, having a total length of about 60 feet.

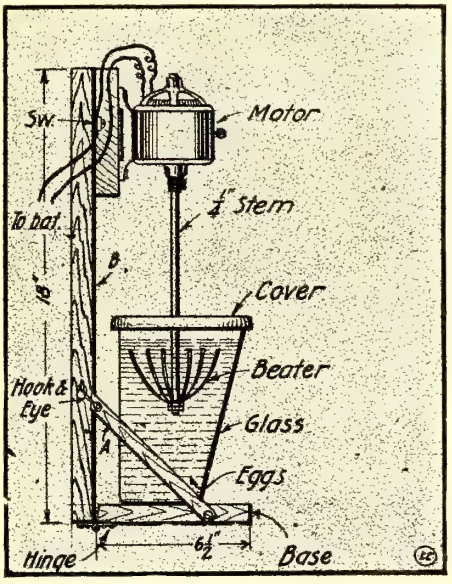
Contributed by E. J. BACHMANN.

The trans-Atlantic wireless stations in Germany have been heard clearly at the University of North Dakota radio station, a distance of 4,300 miles.

ELECTRIC EGG BEATER.

Secure a base 6½ inches long and hinge it onto an 18-inch upright piece as shown. Fasten a block 2 inches thick at top and to this fasten an electric motor. Fasten on the shaft a ¼-inch brass stem and then solder some light strips of tin to the end and bend as shown.

The base has a hinge so it can be low-



Egg Beater Driven by Small Motor.

ered to put glass of eggs on. A is a brace which can be hooked onto B. The motor may be arranged to slide up, so as to remove beater head from eggs or phosphate container without hinging upright. Contributed by CLARENCE LINDGREN.

A TIN-FOIL ADHESIVE FOR CONDENSERS.

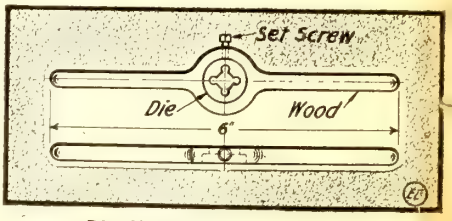
A very good way to secure tinfoil on condenser plates, and one which will not cause blistering, which is so disastrous to condensers, is as follows: Place the plates to be coated in a moderately warm oven and heat them for about 5 minutes. Then remove them and rub the surface with beeswax. Place the tinfoil over the wax and smooth down. It is advisable to place a lug of thin copper ribbon on the plate under the tinfoil before the tinfoil is put on. The corners should be painted with beeswax after the tinfoil has been placed on the glass. It is best to round the corners of the tinfoil sheet. Beeswax is far superior to shellac for this purpose.

Contributed by

WALTER FRANSEEN.

WOODEN DIE HOLDER.

I am sending you a drawing of a home-made wooden die holder which I used because I did not have the right-sized holder for a small die. Bore hole half way through the wood handle as shown, so that die will fit very snugly. Bore a small hole for the threaded rod to go through. Put



Die Holder Made of Wood.

die in larger hole and thread a screw in the notch on the edge of the die as usual. This holder will do real serviceable work.

Submitted by

NELSON RULAND.

HOW TO MAKE SOLDERLESS CONNECTIONS.

Perhaps some readers find trouble in making a good wire connection when solder is unavailable. I think they will find the following very efficient, especially with aluminum wire.

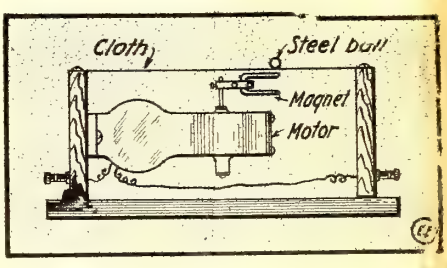
First, scrape about eight inches of the wire to be connected. Be sure all corrosion, dirt, or grease is scraped off thoroughly. Then twist the wires together very tightly. A piece of tinfoil about an inch wide is lapped over the connection twist. The tinfoil should be lapped as tightly as possible without tearing, then pressed together with the fingers. After this lap one or two layers of tape over the tinfoil, so no corrosion or rain can get to the tinfoil. The tape is pulled very tight so as to insure a good connection between the tinfoil and the wire. It is well to paint it with asphaltum.

It should be understood that this little scheme should only be used when solder is not handy.

Contributed by D. K. WALKER.

A MAGNETIC WINDOW ATTRACTOR.

Make a small box 8x4x4 inches. Two inches from one end put a block 3x2 inches. Upon this place a small motor so that the armature does not project over the top. To the armature fasten a small stick with a horseshoe magnet attached to one end of it. Put a very thin piece of cloth over the



Show Window Novelty Easily Made.

top so the inside of the box does not show. Arrange it so that the magnet nearly touches the cloth. On top put a steel ball bearing. To each end attach a binding post. the ball will follow the rotating magnet. A glass mirror top on the box is best, but requires a stronger magnet than when cloth is used. Contributed by

EARL PRATT.

ELECTRICITY, THE POWER

By

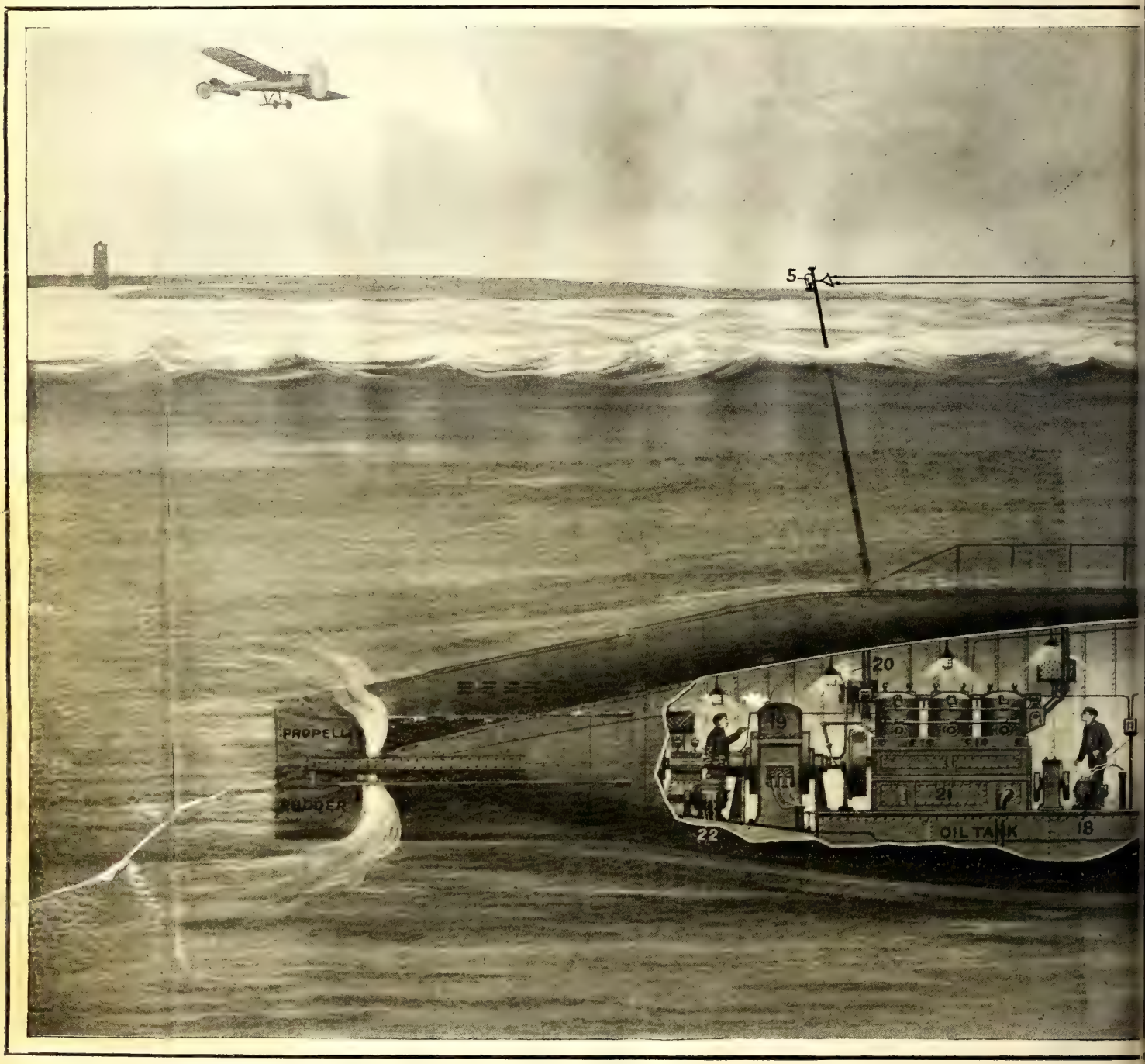
THE submarines have proven, even thus far in the great European war, that they are indeed of extremely valuable service and that even though they are much cheaper to construct than the wonderful "dreadnoughts" costing ten to twelve million dollars apiece, they can on the surface of the water they invariably make use, of course, of gasoline or internal combustion engines, using crude oil such as the Diesel type.

For this kind of cruising some of the latest United States submarines make use of a 900-h.p. Diesel oil engine, which makes it possible for these boats to attain a speed of 14 knots, and sufficient oil fuel is usually carried, enabling them to make a cruise of 5,500 miles.

Several of the submarines of this type, which took part in the recent Naval Demonstration and Review in New York Harbor, made a 1,500-mile run up the coast from Florida without incident, under their own power. Thus, it is seen that Uncle Sam's underwater boats are on par with those of the German and other navies.

At present there are about 35 submersibles in actual commission, and the total number, including those being built and those undergoing repairs, is 55.

Electricity is the wonderful form of energy which enables these craft to be propelled through the water submerged for distances of 100 and more nautical miles at a maximum underwater speed of from 10½ to 11 knots. Powerful electric motors drive the propeller blades for this under-



KEY

1. Periscope for viewing the enemy from below the water line, as perceived.
2. Electric search light for use on surface, when cruising.
3. Centralized control standard for surface cruising.
4. Wireless Antenna.
5. Electric signal and running lamps.
6. Periscope view finder.
7. Telephone.
8. Centralized control standard for submarine running.
9. Latest type gyroscopic compass.
10. Electric lights.
11. Wireless switchboard and appara
12. Electric trigger for discharging tor
13. Electric submarine signalling device

very easily and shortly, under certain conditions, dispatch these great fighting-ships to the bottom of the seas in a few minutes' time.

Probably more than is generally realized, electricity is really the backbone of these wonderful underwater engines of destruction. When these submarine boats travel

IND THE SUBMARINE BOAT

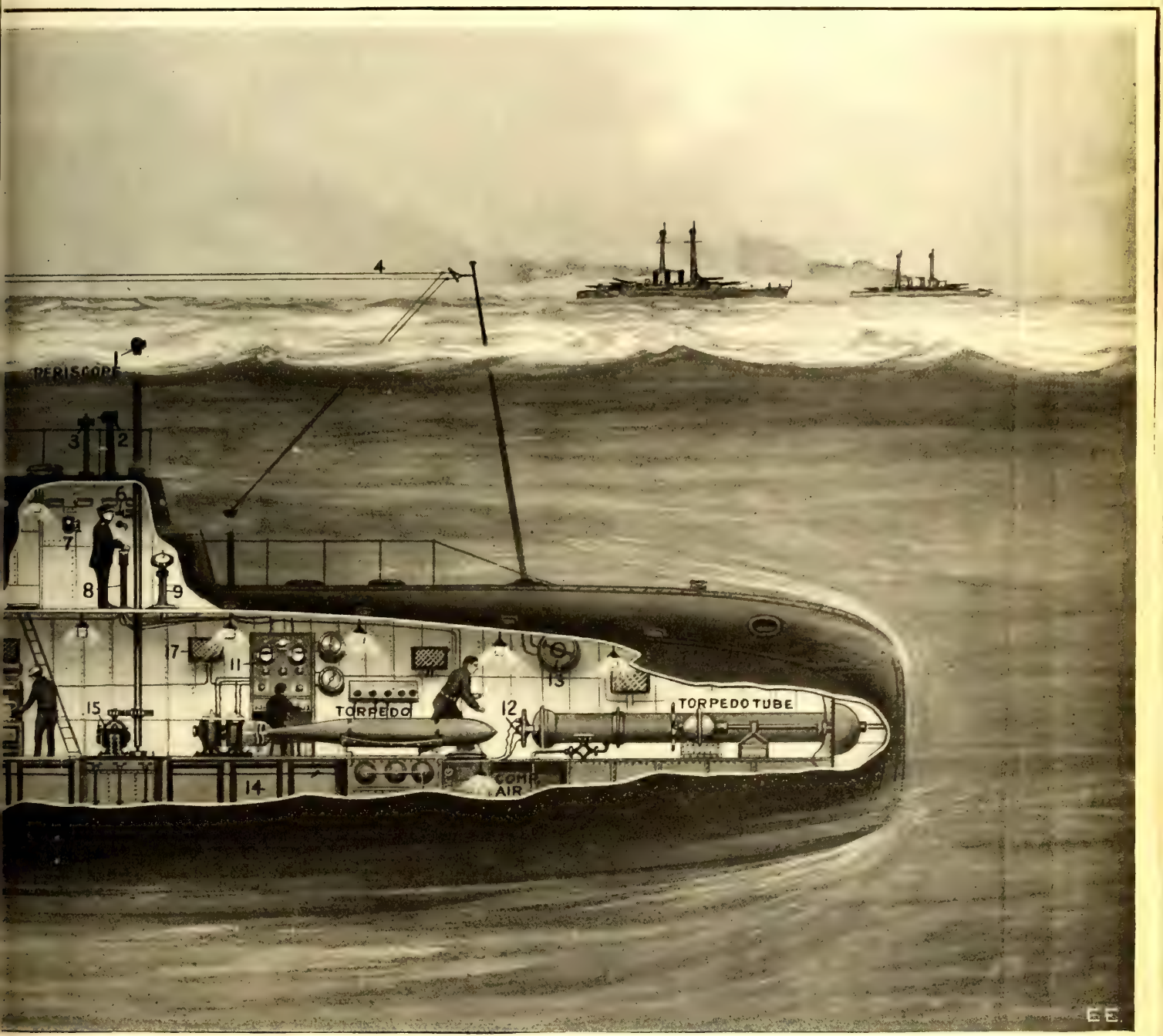
Secor

water propulsion, the motors developing 650 h.p. at the above full-speed rating in knots. These motors and all of the other electrical appliances on board the submarine obtain their energy from storage batteries, which, of course, have to be quite large. Practically all storage batteries including Thomas A. Edison, are and have been working for a considerable time toward perfecting a storage battery for this class of work which would not give forth poisonous fumes, etc.

Mr. Edison's latest submarine storage battery promises to fulfil these requirements in very good shape, besides having several other features which can be turned to good account in the submarine installation, such as revitalizing the air, etc.

The illustration herewith given shows a number of the more important uses to which the electric current is put on board the submarine. Of course, all the larger and latest type boats of this character carry a high-grade wireless set to be used with an antenna supported between two steel masts, as will be seen. It is claimed that the Germans have obtained much of their inside or secret information from spies, etc., by means of wireless messages sent out from secret or hidden wireless stations on land in England, and which messages have been picked up by some of the German submarines lying off the coast a few miles. These submarines can then of course, cruise away until they get within touch of some wireless communication

(*Continued on page* 124.)



TRATION

Photo (C) By E. P. Co.

-arge storage battery.
Electric motor for turning periscope.
Electric stove for cooking crew's meals.
Electric heaters for warming the interior of the submarine.
18. Circulating pump for engine, driven by electric motor.
19. Powerful electric dynamo used for charging batteries on surface, which acts as electric motor for driving the submarine when below surface.
20. Shifting gear to throw propeller on engine or motor drive.
21. Internal combustion engine, such as Diesel type.
22. Electric motor operating steering gear.

ELECTRICITY, THE POWER BEHIND THE SUBMARINE BOAT

By H[illegible] Secor

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KEY TO ILLUSTRATION

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9. Latest type gyroscopic compass.
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11. Wireless switchboard and apparatus.
12. Electric trigger for discharging torpedo.
13. Electric submarine signalling device.
14. Large storage battery.
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These batteries make use of sulphuric acid, of course, and hence they give off very poisonous fumes, which often endanger the health or even lives of the crew when the boat is submerged for a number of hours. Therefore several inventors, including Thomas A. Edison, are and have been working for a considerable time toward perfecting a storage battery for this class of work which would not give forth poisonous fumes, etc.

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(Continued on page 124)

WIRELESS DEPARTMENT

New Arc Radio Set For Ships

A NEW arc type wireless outfit was recently developed by the DeForest Radio Telegraph & Telephone Co. for use on ships. The photograph shows the complete outfit as it is installed on the steamship *Wm. Chapman.*

The transmitting set consists of an arc of special design, shown at center of switchboard in photograph. This arc contains two gaps in series, operated by 600

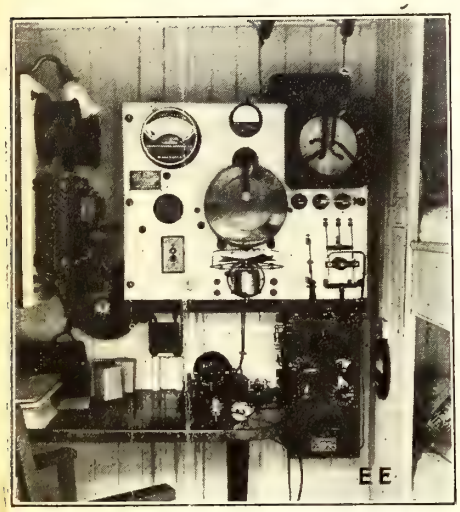


Fig. 2. Showing New Arc Radio Generator Installed on the Steamship "Wm. Chapman."

volts direct current, supplied by a motor-generator set.

The electrodes, P in the diagram, Fig. 1, consist of an alloy of platinum which has a very high melting point. The large discs O act as heat radiators, and the gap is also cooled by a fan below it, as shown. The gap between the electrodes is regulated by a thumbscrew Q placed in front of the arc. Fig. 1 shows the exact construction of this arc. The secondary circuit of the arc consists of a condenser behind the switchboard, a helix mounted on the right-hand front corner of the switchboard, hot wire radiation ammeter and a control switch for changing from 600 meters to 300 meters wave length. An aerial throw-over switch is also mounted at the extreme right. The primary circuit includes an ammeter mounted on the extreme left of the switchboard and connected in series with a choke coil, etc., as the diagram indicates.

The most interesting part of this arc is in starting it. When starting every arc it is first necessary to close both electrodes together and after separating them an arc is then formed, but with this radio arc it is only necessary to close a switch, which short-circuits the generator for a moment through a powerful choke or impedance coil and suddenly opening the switch. As soon as the switch is opened an arc is formed at this contact of the switch, which is extinguished by blowing it. The arc at the special gap electrodes is immediately formed. The distance between the gaps is about one-eighth of an inch long.

When in operation this arc produces undamped oscillations which cannot be received with the ordinary detector on ships, so a specially designed rotary commutator is employed for changing these undamped oscillations into ordinary spark oscillations of lower frequency. This device is called a "chopper" and is seen on top of the table. With this chopper the operator can send to ships and also to land stations having the Poulsen tikker receiving outfits just by cutting out the chopper, which is done by means of a double-pole single-throw switch next to the motor when the arc's undamped waves are sent out.

The motor-generator is located in the engine room and is operated by a hand control switch and an automatic solenoid switch. The panel on the extreme left of the room shows the generator board with all the necessary instruments, including ammeter, etc.

This particular outfit is rated at 2 K. W. and a maximum aerial reading of 5 amperes is obtained. The aerial consists of six wires 40 feet long. The receiving outfit consists of the latest type Audion detector and is seen on the right.

Simplicity is the principal feature of this well-built set, which is a new departure in American-made wireless apparatus.

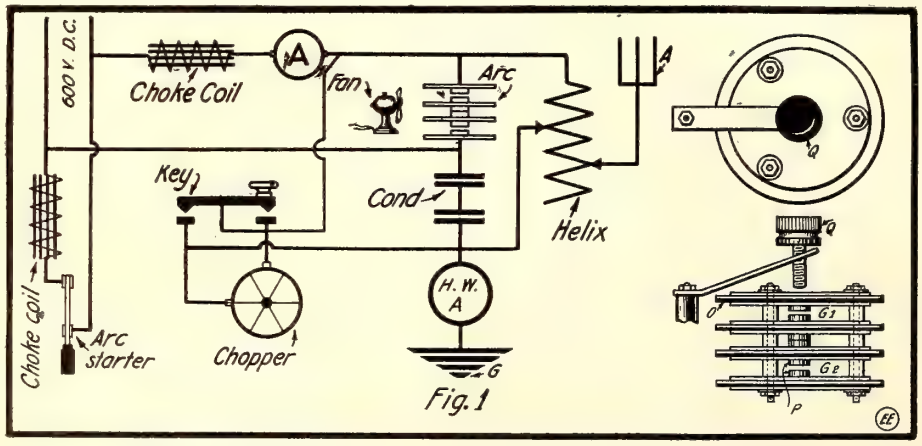


Fig. 1. Diagram of the New DeForest Arc Type Wireless Transmitter.

THE KEYSTONE WIRELESS ASSOCIATION.

The Keystone Wireless Association was organized in February, 1915, with six members, B. Bimson, William Boyle, L. Clancy, H. Forker, S. Hancox and W. Rusling.

The members meet in the basement of Brother Bimson's house every Saturday night at 8 o'clock to practise the code and qualify for a license, or anything else that they wish to do. We have a small library with wireless books such as *The Electrical Experimenter.*

We would like to have any young men interested in wireless and between the ages of 17 and 25, inclusive, to join. Anyone desiring information will receive same by writing or calling on S. Hancox, 685 Lexington avenue, Brooklyn, N. Y., any evening.

RADIO CLUB OF AMERICA MEETING.

The last meeting of the Radio Club of America before the summer holidays was held May 29 in Fayerweather Hall, Columbia University.

NEW ARC FOR RADIO-TELEPHONY.

A new system of radio-telephony was recently put into operating condition by a Brooklyn inventor. Short distances up to five miles have been covered very successfully with this new system, which employs a special arc.

The telephone transmitter oscillation generator consists of a specially designed arc with a gas chamber that receives illuminating gas, and also ammonia gas under high pressure is sent through a small co-



Inventor Using His Improved Type Radiophone Arc.

axial hole in the metallic anode. This gas is used to maintain the oscillations steadily and at the same time to cool the arc, thereby eliminating the use of water for cooling the anode. A variable capacity and an inductance is shunted across the arc in such a manner that a continuous stream of oscillations is produced. The frequency of these oscillations was controlled by means of the variable capacity of the air dielectric type. The arc was operated on 11,000 volts A. C. and continuous oscillations with a constant amplitude are readily produced.

The variation of sound is produced by a specially designed water-cooled transmitter. Under operating conditions the transmitter has stood continuously three amperes without any sign of heating whatever. The receiving set was the ordinary crystal type with an inductance and a variable capacity. The inventor has found that a combination of galena and zincite gave the clearest sound in the receiving set.

Dr. Alfred N. Goldsmith, of the College of the City of New York, presented a most interesting and instructive paper on "Foreign Radio Apparatus." The paper was plentifully illustrated by lantern slides. The Telefunken, Goldschmidt, Lorenz and Poulsen, Berliner-Poulsen and Compaignie Générale Radiotelégraphique systems' apparatus were shown by lantern slides and later discussed by R. H. Marriott, B.S.; Dr. Zenneck, Dr. Wheeler and others.

A Wireless Lecture Set

A simple, yet effective, wireless lecture or demonstration set is always in great demand, and herewith is illustrated and described a satisfactory outfit of this type which can be built for a reasonable sum.

The apparatus comprises a filings coherer, a decoherer, two relays of about 75 to 100 ohms resistance or even less (but preferably of a much higher resistance than this), together with controlling switches, batteries and the electrical devices to be controlled by the relays.

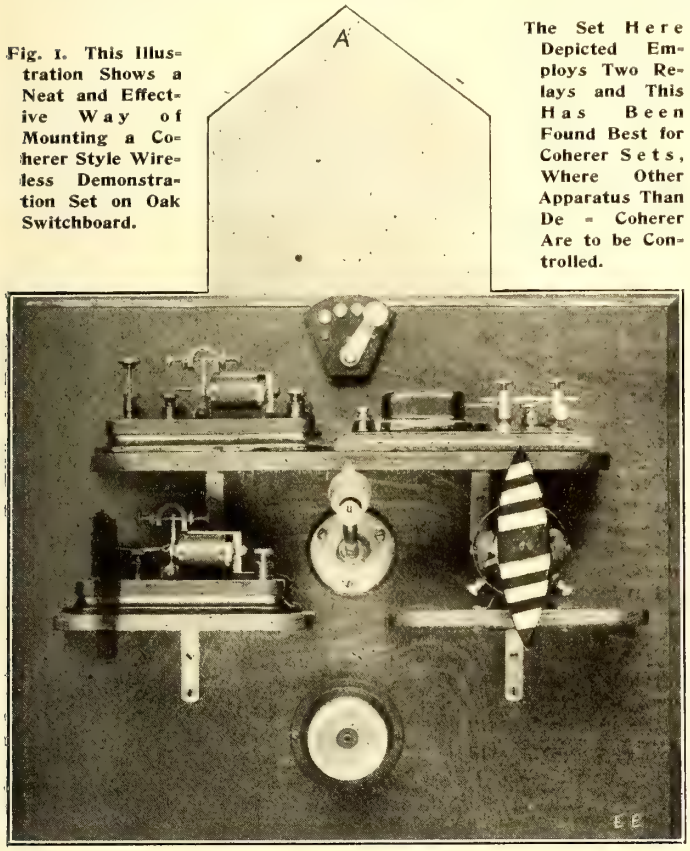


Fig. 1. This Illustration Shows a Neat and Effective Way of Mounting a Coherer Style Wireless Demonstration Set on Oak Switchboard.

The Set Here Depicted Employs Two Relays and This Has Been Found Best for Coherer Sets, Where Other Apparatus Than De - Coherer Are to be Controlled.

Fig. 1 shows a photograph of such a set, which works very nicely indeed. This is a good way in which to mount the various apparatus so as to be clearly seen by the audience; a couple of small shelves serve to support the instruments, as will be observed.

Referring to the diagram of connections for this outfit at Fig. 2, the general operation and arrangement of the set will be more clearly understood. A metal plate, which also shows in Fig. 1, and made of copper or aluminum, is indicated at "A." This plate may be about 12 inches square and any thickness.

The filings coherer "C" is tapped or decohered by the vibrating bell mechanism "D." Not more than one dry cell at "B1" should be connected in circuit with relay "R1" and the coherer.

It has been found best for such sets to use a second relay "R2" with which to control various demonstrative apparatus, such as electric whistle, lamps, motors, etc. These devices will be observed on the panel in Fig. 1, and the motor has a piece of metal fastened to the shaft so that its movement will be quickly and easily discerned. It is also a very good idea to mark some white bands on the strip of metal fastened to the motor shaft, so that its movement will be more quickly noticed.

The relays for this set are simply those known as "pony" telegraph type, etc., and while for short distances up to 50 to 75 feet it is not necessary to use any ground capacity "G" (corresponding in size to the metal plate "A" previously mentioned), this capacity should be used as shown in dotted line at Fig. 2 for greater distances than those mentioned. For distances above 150 to 200 feet it is best to use 10-15-foot brass tubes, etc., or a small aerial made of copper wire, etc., with a metal plate several feet square for the ground capacity or counterpoise. These sets, of course, should be operated, whenever possible, without any ground connection, as audiences in general are very skeptical on these matters, and if they find or see a direct ground connection they immediately believe that the apparatus is a fake.

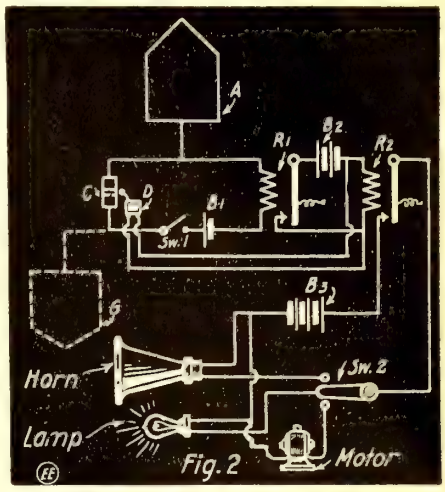


Fig. 2. Diagram of Coherer Set Connections.

A 1-inch spark coil proves very good for the transmitter, and this is usually mounted on a 5 or 6-foot pole with batteries, so as to be carried through the audience, allowing anyone to press the push-button actuating the coil. A ball spark gap should always be used for these lecture sets. For an aerial a 3-foot brass tube may project above the coil and connect to one side of the spark gap. Two such tubes at right angles act well as "aerial" and "ground," connecting each to alternate sides of the spark gap.

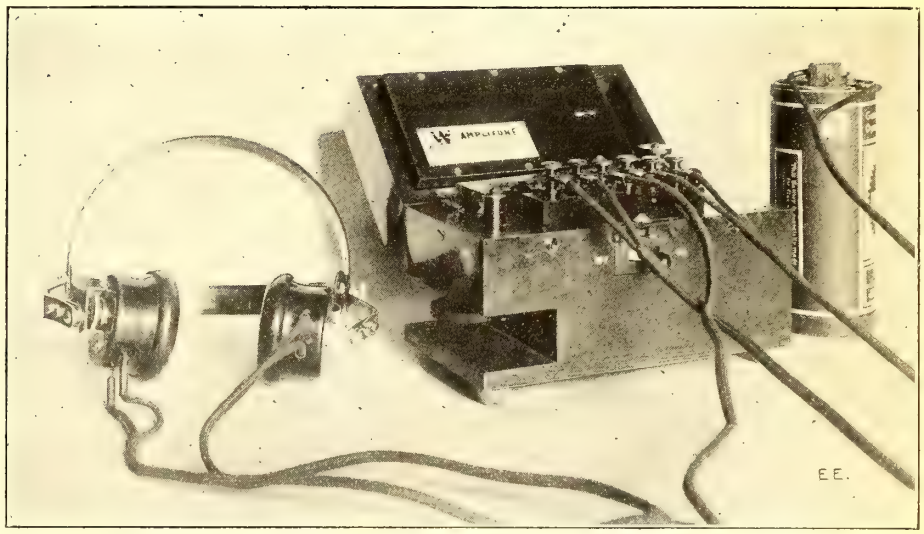
WIRELESS FROM NEW YORK TO BELMAR.

Randolph Miller, Edward Taylor and Frank E. Hoyer, all of Asbury Park, were appointed recently by Justice Kalisch, of the Supreme Court, as condemnation commissioners to fix the price of land wanted in Belmar, N. J., by the Marconi Telegraph Cable Co. for the establishment of a wireless station.

Application for the commissioners was made by John L. Grigg, president of the Marconi Co. The company's main station is at New Brunswick, and the justice was told that it was desired to establish wireless communication between Belmar and New York.

A MICROPHONIC RADIO-AMPLIFONE.

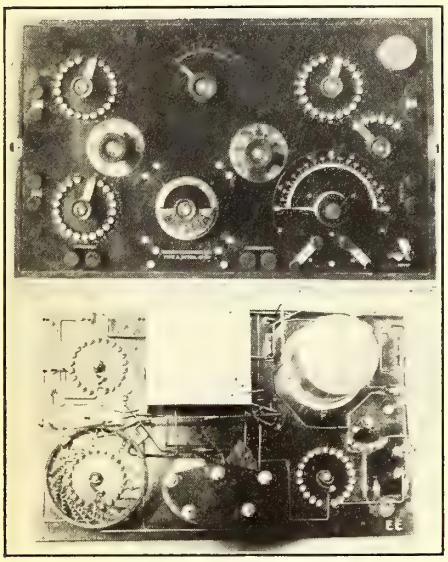
A new wireless amplifone for the amplification of received radio signals is herewith illustrated. This instrument was developed by a well-known American wireless company and it is extensively used in the United States navy and army. The principle upon which this amplifone works is that of the microphonic contact. There are within the box several microphones of special design and each one is connected in series with the next. The instrument is connected to the radio receiving set in place of the regular telephone receivers, and a battery is connected in series with the pair of phones and the microphones as shown. Each microphone amplifies the incoming signal with a different amplification strength until the last microphone stage amplifies it very considerably. By using more microphones the stronger the received signals will be amplified.



Standard Navy Type Amplifone Employing Extra Sensitive Microphones.

NEW U. S. NAVY RADIO RECEIVING SET.

Dr. Louis Cohen, of the Bureau of Standards, has recently perfected a new radio receiving set which has been adopted by the United States Navy as its standard receiving set. It is illustrated in Fig. 1.



(Above:) Fig. 1. Shows Front View of U. S. Navy Radio Receptor.
(Below:) Fig. 2. Rear View of Same.

The rear view is shown in Fig. 2. The connection of each individual instrument is represented in diagram Fig. 3, where A, C_1, L_1, constitute the primary or antenna circuit and C_2, L_2 constitute the secondary circuit. The two circuits are electrically linked together through two small condensers C_o, C_o, and any degree of coupling may be obtained by varying these condensers. This method of coupling offers several advantages. They are: (1) Compactness; (2) increased efficiency; (3) higher selectivity; (4) simplicity in operation. In regard to the first point it is quite obvious that by eliminating the receiving transformer, or loose coupler, a considerable economy in space may be accomplished, which makes it possible to build a receiving set of comparatively small dimensions for a large range in wave lengths. The second and third points have been definitely settled by a large number of comparative tests with other receivers of the best known types on the market.

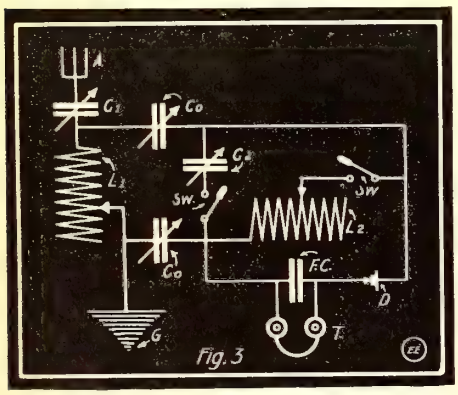


Fig. 3. Diagram of Dr. Cohen's Improved Navy Type Receiving Set.

The instruments are mounted on a hard rubber board and are connected by stranded copper wires. Note that all the wires are placed as nearly at right angles as possible. This was done in order to prevent cross induction, which may occur. Any wave length from 150 meters to 4,000 meters can be obtained quickly with this receiving set.

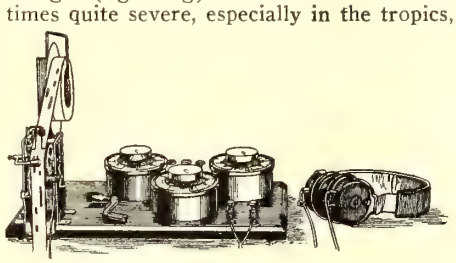
Dr. Louis Cohen has done a considerable amount of work in tabulating formulae for the determination mathematically of inductance and capacity values, and his latest product in the form of an efficient radio set will undoubtedly be very extensively applied.

All of the coils and other parts, such as condensers, are calibrated in their correct electrical values, and the finish and workmanship are of the very highest standard.

A NEW WIRELESS CODE TEACHER.

An improved form of automatic wireless code teaching machine, known as the Raydeograph, has been perfected, which does not use buzzers or vibrators. The device is here illustrated and appears of great value in all-around teaching where students have no access to schools, etc. It is also used in schools.

It quite often happens, in wireless, that an operator is compelled to copy one station through the "jamming" or signals of a second station, in which case two signals are heard in the telephones at the same time. After considerable practise an operator can concentrate his mind on one signal and disregard the other. These aerographic conditions are produced by the double tapes provided with the Raydeograph to perfection, with the additional advantage that the intensity of the individual signals can be varied at will. The student may manipulate the controls so that the "jamming" signal is much weaker than the one he is copying, but as he becomes more proficient in the art of copying through interference he may increase the intensity of the "jamming" signal or decrease that of the one he is copying. Now, by copying first one series of characters through the "jamming" of the other series, then *vice versa*, it will be seen that each tape contains four code lessons. Another novel and decidedly practical Raydeograph feature is the Static Producer. It should first be explained that "static" or "x's" are false signals or an etherial disturbance caused by the effect of atmospheric electrical discharges (lightning). These "x's" are sometimes quite severe, especially in the tropics,



Improved Form of Radio Code Teacher.

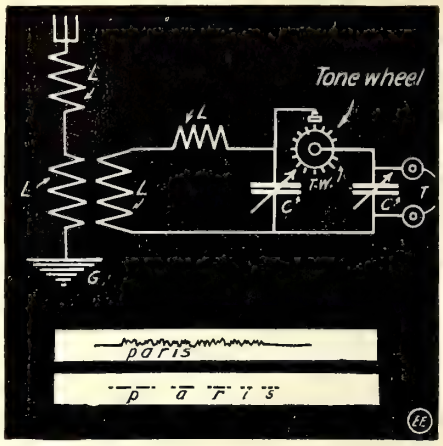
and it is often necessary for an operator to copy a station or signals through this interference. The Static Producer causes disturbances in the telephones identical with these X's, and by manipulating the rear left Raydeograph control the intensity of this interference is varied.

While in use at the Amherst Branch of the Nova Scotia Technical Schools this instrument has operated successfully with 27 telephones in circuit. The machine is contained on a base 8x13 inches and may be mounted on a small table or desk.

The D. L. & W. R. R. recently conducted successful wireless telephone tests between a moving train and station set, over a range of 63 miles, in mountainous country. Regular business made up the messages.

THE GOLDSCHMIDT TONE WHEEL DETECTOR.

One of the cleverest and also simplest radio detectors, if so we may call it, used for the reception of undamped wireless waves is that known as the "Goldschmidt Tone Wheel." We show illustrations herewith (see Fig. 1) of this ingenious device, which consists of a metal disc with a large number of teeth cut in its outer periphery



(Above:) Fig. 2. Circuits Used With "Tone Wheel."
(Below:) Fig. 3. Tape Records of Radio Signals.

and a finely adjustable brush making contact with the edge of the rapidly rotating disc.

The operation of this device is as follows: A special motor drives the toothed disc at such a speed that, considering the number of teeth and the revolutions per second, the number of breaks in the circuit per second will be slightly lower or higher than the frequency in cycles per second of the incoming etheric wave.

Suppose, for instance, that the currents to be received have a frequency of 40,000 cycles per second. Then, if each tooth of the tone wheel has a width of 1 millimeter, there will be a synchronous rotation for a circumferential velocity of 40,000 times 1 millimeter or 40 meter-seconds.

Owing to the difficulties of producing a constantly synchronous rotation it has been arranged for the wheel to rotate at a slightly different value than the frequency of the incoming wave. As an example, a frequency of 39,000 or 41,000 could be used for a wave frequency of 40,000 cycles.

Then the frequency of the "note" heard in the telephone receiver in the circuit, shown at Fig. 2, would be what we might

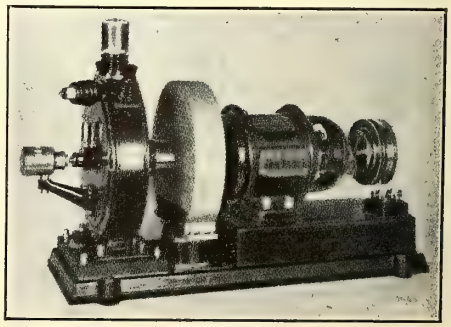


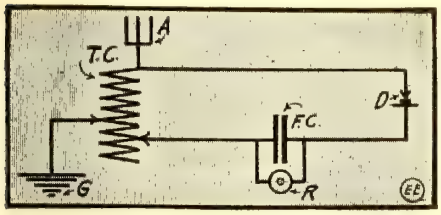
Fig. 1. The "Tone Wheel" is Driven by an Electric Motor at High Speed.

term for convenience the "beat" frequency, or the difference between, for instance, 40,000 and 39,000, or 1,000. Thus a perfectly audible tone is produced from a radio-frequency current which, of course, is far above audibility.

(*Continued on page* 109.)

A VACATION WIRELESS RECEIVING SET.

No doubt many of the wireless experimenters are about to go to the country on their vacations and they need not part with their instruments, as quite a compact receiving set can be readily made suitable for carrying about the same as a camera.



Circuit For Vacation Radio Set.

The case in which the instruments are placed is an ordinary hand valise, that can be obtained for about 50 cents, or a box of similar size. The instruments which comprise this set are an ordinary single slide tuning coil TC, a silicon detector D, fixed condenser FC, and a pair of 'phones R, of 2,000 ohms resistance, preferably. The tuning coil is fastened to the case by means of three screws, as shown. The detector and condenser are also fastened in the same manner. After the instruments are arranged connect them as in diagram.

The aerial or antenna should next be considered. There are several methods of erecting an aerial for temporary operations. One of these consists of flying a kite and attaching the aerial, in the form of a thin copper lead, such as No. 28 or 30 B. & S. gauge, to the kite string. Trees form good support for aerials. Sketch shows a method of supporting an aerial from a tree. Care should be taken to see that the wires do not touch any leaves or any part of the tree. The ground or earth connection can be made to any metallic body well grounded in moist earth, or a piece of pipe driven into the ground. If water pipes are available they should be used.

In using the set the detector is first adjusted until signals are received best, but a buzzer test is of course the quickest way to adjust it, and therefore it is advisable to install a buzzer test on this outfit. This set will be very useful to the experimenter in obtaining the latest baseball and other news and correct time signals, et cetera.

THE GOLDSCHMIDT TONE WHEEL DETECTOR.

(*Continued from page* 108.)

If a suitable high-frequency A. C. galvanometer is placed in series with the tone-wheel circuit very excellent tape records may be taken of the dots and dashes, as Fig. 3 shows. These were registered photographically on a moving film.

The upper curve in Fig. 3 shows a record produced by means of an ordinary crystal detector, and the lower record shows the remarkable clearness of the signals registered with the tone-wheel receptor.

Although this machine has been repeatedly classed with that invented by Prof. R. A. Fessenden, known as the "Heterodyne," it does not operate on the same principle at all, as will be evident.

This tone wheel simply acts as a frequency changer, while the Heterodyne produces its results by the amplification due to superimposing a high-frequency alternating current on the radio-circuit, and "beats" are thus produced of low frequency which depend upon the difference between the frequency of the etheric wave and the superimposed artificial wave. No such beats are produced in the Goldschmidt device.

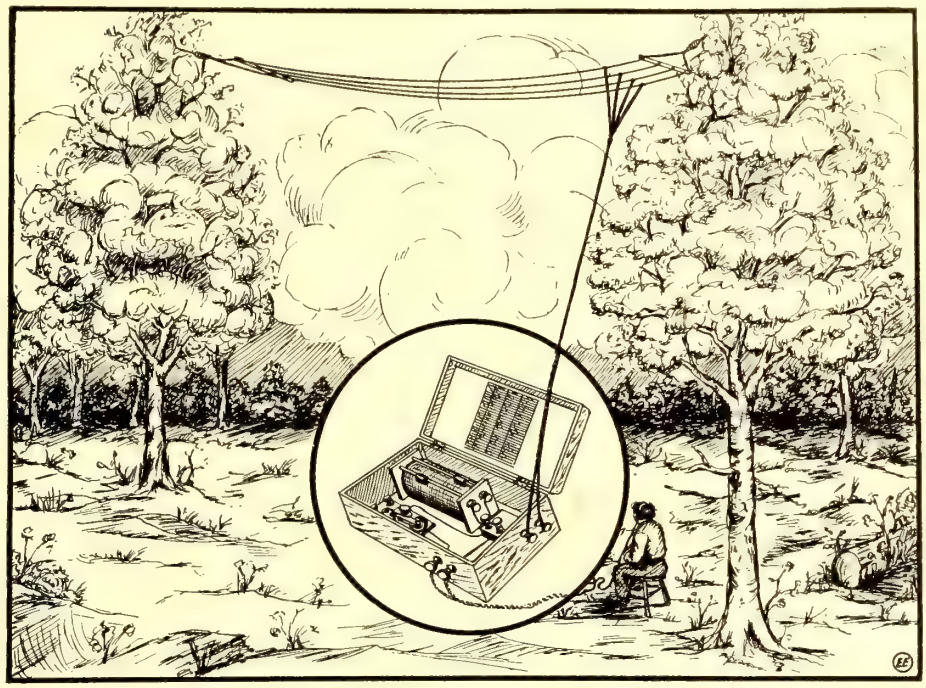
TALK BY WIRELESS PHONE 721 MILES.

Sponsored unofficially by the Secretary of the Navy, a wireless telephone invented by H. P. Dwyer, a San Francisco man, has carried the human voice 721 miles. The conversation was exchanged between the United States Government radio station at Mare Island and the Government station at Tatoosh, Cape Flattery, on the coast of Washington.

During the test Mr. Dwyer's voice was also heard at Bremerton, a distance of 560 miles; at Point Arguello, at Eureko and by the Government radio operator at San Diego.

The call sent from Mare Island was received on wireless telegraph sets, and the replies were telegraphed back. Through the perfection of certain parts of the new invention Dwyer says that it is possible to telephone in any kind of weather.

Mr. Dwyer asserts that he could have been heard at 1,000 miles if there had been a radio station to receive his message, and that with the proper aerial, 500 to 600 feet high, there is no reason why the human voice cannot be distinctly audible from San Francisco to Honolulu.



How Aerial May Be Erected Between Two Trees for Receiving Wireless Messages.

A round magnet coil contains the least resistance with a given core cross-sectional area.

BLOWING UP A TOY BOAT BY WIRELESS.

Here is a new and exciting sport for boys who know a little about electricity, especially for boys who have wireless apparatus. It was devised by Prof. Charles Forbes, of Columbia University, to prove that a submarine bomb cannot be exploded by wireless waves except through a special apparatus, says the *Sunday World*. With such apparatus, which is easily made at home, you can explode bombs under toy ships floating in the bathtub or a washbowl.

At Fig. 1 is shown a diagram of the apparatus for exploding a mine by wireless. A, coherer; B, primary batteries; C, relay; D, batteries of the relay; E, vessel of water containing miniature mine.

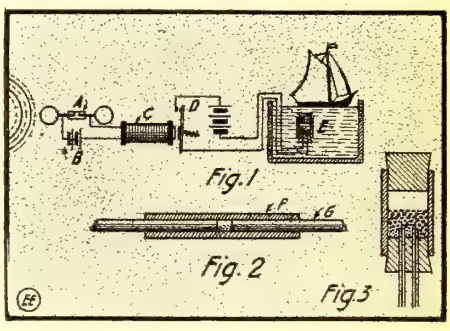
Anyone who has not a wireless apparatus can make use of an induction coil or a Leyden jar for producing the waves. A Branly tube arranged in series with two or three dry batteries will form the receiving apparatus, and this is completed with a relay from which wires run to the fuse of the mine.

The electric waves, whether real wireless or discharged from a Leyden jar, act upon the coherer, the battery of which closes the relay circuit. The coherer is made of a glass tube about 1½ inches long, into each end of which a rod of copper or brass is introduced. Between the ends of the rods there should be a space about $\frac{1}{16}$ inch long filled with filings (nine parts nickel and one part silver). Metal balls are fitted to the other ends of the rods. Such a coherer offers great resistance to the passage of the current from the battery, but the wireless waves greatly increase the conductivity of the filings, and this is enough to set the relay in action.

Fig. 2 shows details of the coherer; F, glass tube; GG, copper rods, and Fig. 3 the miniature submarine mine.

The mine is made as indicated in diagram Fig. 3. It is a metal tube about three-quarters of an inch long, closed at each end with a rubber cork and the space inside loaded with ordinary gunpowder. Through the lower cork the insulated wires from the relay battery are inserted, and

(*Continued on page* 110.)

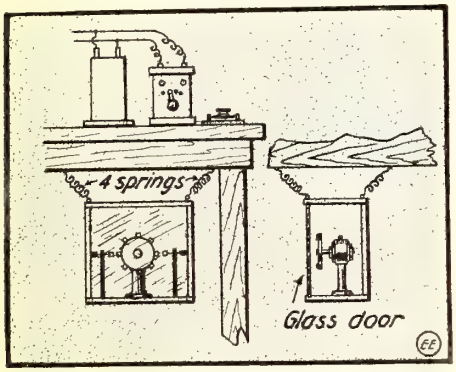


Wireless Method of Blowing Up Miniature Ship.

MOUNTING SPARK GAPS TO ELIMINATE NOISE.

A very novel and at the same time effective method of mounting or, rather, suspending a rotary spark gap, has been made use of by a New York radio experimenter.

As the illustration shows quite clearly, the rotary gap with its motor is mounted in a substantial wooden cabinet with glass



Spark Gap Noiselessly Suspended on Springs.

front and this cabinet is suspended on four strong spiral springs from the underside of the operating table.

The glass door on the cabinet should close tightly and, owing to the method of suspension used, practically no vibration noises are transmitted beyond the wireless room.

BLOWING UP A TOY BOAT BY WIRELESS.

(*Continued from page* 109.)

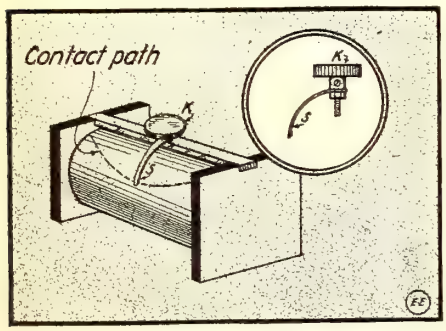
their ends are joined by a very fine wire of iron or platinum. This rests in the middle of the powder. As soon as the current passes through it becomes red hot and the powder explodes.

The mine is placed in the bathtub and a toy boat is sent sailing over it. At the right moment the Leyden jar is discharged, the coherer catches the waves of electricity, closing the main circuit; this actuates the relay, which sends the current of its batteries into the mine. This explodes and blows up the toy boat.

Such mines can, of course, be exploded by direct current from a battery, the circuit being completed with a telegraph key corresponding to harbor mines fired by electricity.

A ROTARY TUNING COIL SLIDER.

In the accompanying sketch is shown a



Simple Tuning Coil Slider.

type of rotary slider that can be used advantageously on tuning coils of average length and diameter. In the center of the slider bar of the tuning coil bore a hole of suitable diameter to pass an 8-32 machine screw. Then take a piece of 1-32x½-inch spring brass S about half the length of the tuning coil, and at one end of the spring bore a hole in order to secure it to the slider bar and knob K. With a little adjustment it will be found possible to have the end of the contact spring follow the circular path on the coil as indicated.

Contributed by

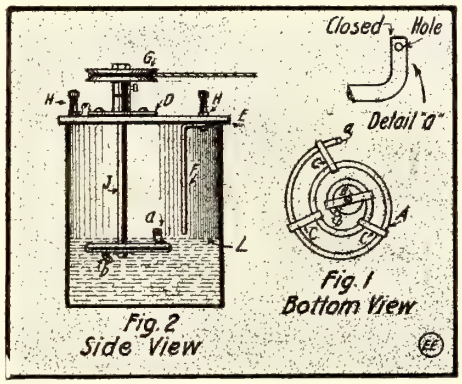
CHARLES F. ENGLER.

CONSTRUCTION OF A MERCURY TURBINE INTERRUPTER.

The main drawback in the construction and operation of spark coils is the interrupter. The interrupter here described is of the mercury turbine type, which can be used for very large spark coils.

The first thing to be made is the spiral tube A, Fig. 1. This is made of one-quarter inch brass tubing having a small internal diameter. It is then bent into a spiral as shown. This is readily done by placing the tube in a fire and then bending it to the required form. The ends (a) and (b), Fig. 2, are next bent as shown. The lower bend is used to suck the mercury in, while the upper bend is used to force the mercury out of. A round brass disc and a shaft are next made. The disc B is made 2 inches in diameter and ¼ inch thick. A ¼-inch shaft hole is drilled at the center. A ¼-inch brass shaft rod J is then inserted tightly in the disc. The spiral should next be placed on the disc and mechanically fastened (but not soldered) around as shown. Three brass strips C are secured around the spiral in order to strengthen the whole.

After these parts are completed the spiral is placed into a glass container. The spiral and shaft are supported by a brass collar D, Fig. 2, which is fastened by means of wood screws onto the cover E. A second contact F is next made, which consists of a brass sheet 1 inch wide. The segment F can be of different widths to give dif-



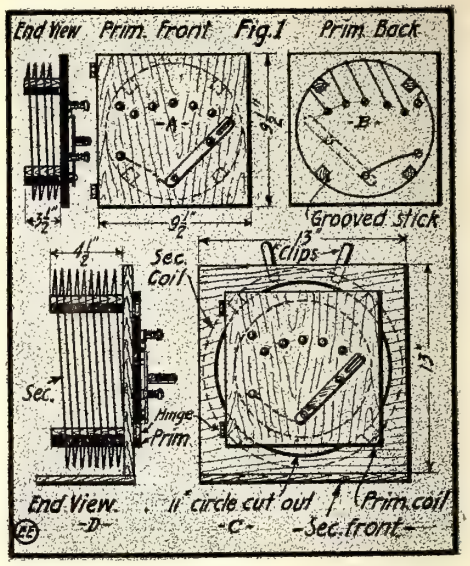
A Mercury Turbine Interrupter.

ferent results; so several of them should be made up.

The container is next filled with metallic mercury up to level L, and the shaft is rotated by means of a motor connected to the pulley G. The spark coil is connected in series with the source of power and the mercury interrupter from binding posts H H. When this interrupter is properly built it will interrupt the primary circuit between 300 and 2,000 interruptions per minute, depending upon the speed that the spiral is revolving at. The usual primary condenser is connected across the posts H H, and is best of the adjustable type for good results, especially when different width segments are used. The mercury will combine with solder, so the spiral must be mechanically braced or else brazed with *brass* solder.

A PROF. MODEL OSCILLATION TRANSFORMER.

A very efficient oscillation transformer may be made in the following manner. By a close study of the diagrams a good idea of its construction may be obtained.



Efficient Form of Oscillation Transformer.

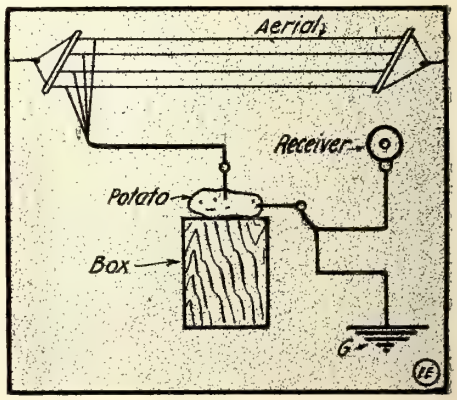
The base and other wooden parts should be made from good dry oak or other hard wood. The primary (Fig. 1) is wound with five turns of No. 6 aluminum helix wire with half-inch spacing. Each turn is tapped and brought to a five-point switch on the front (Fig. 1a) so that the wave length can easily be regulated.

The secondary is wound with eight turns of No. 6 or No. 8 aluminum wire, spaced about one-half inch, and is adjusted by two clips (see Fig. 1c).

Submitted by PAUL FLEHR.

A POTATO DETECTOR.

While putting up an aerial in my yard (80 feet long and 60 feet high) recently I tried to receive wireless messages. I took a potato and placed it on a box. Then I took two sewing needles. I took one needle and stuck it into one side of the potato. I then connected the second needle with one pole of the receiver and stuck it in the other end of the potato. I took the ground wire and connected it with the other end of the pole of the receiver, and when this was



A Potato Acts As Wireless Detector.

completed I was able to receive many messages just as clearly as from a detector.

Contributed by

MILTON ROCHKIND.

(An electrolytic action, no doubt.—*Editor.*)

HOW-TO-MAKE-IT DEPARTMENT

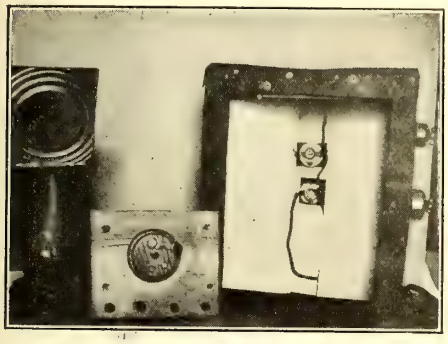
This department will award the following monthly prices: FIRST PRIZE $3.00; SECOND PRIZE $2.00; THIRD PRIZE, $1.00.
The idea of this department is to accomplish new things with old apparatus or old material, and for the most useful, practical and original idea submitted to the Editors of this department, a monthly series of prizes will be awarded. For the best ideas submitted a prize of $3.00 will be given; for the second best idea a $2.00 prize, and for the third best a prize of $1.00. The article need not be very elaborate, and rough sketches are sufficient. We will make the mechanical drawings.

SECOND PRIZE $2.00.

AN IDEAL ELECTRIC RUBY LAMP.

The lighting system which I am sending herewith is one I have in use at the present time and I would never be without it.

My first experiment was with an old oil ruby lamp converted into an electric lamp,

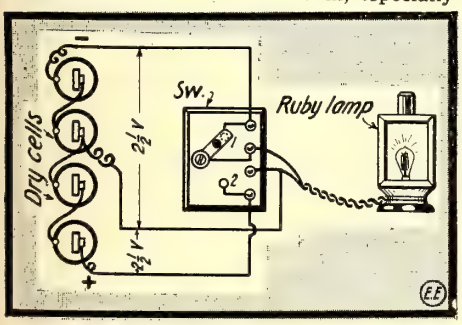


Electric Ruby Lamps For the Amateur Photographer.

as I have illustrated in drawing. In this drawing will be seen a two-point switch, mounted on a small board having four binding posts, for making quick connections.

With the aid of this board I have used four dry cells for almost a year by simply throwing the switch from one point to the other, whenever I think of it while in the dark room, which allows two cells to rest while the other two are working. This should be a great relief to any amateur photographer, and can be used also where continuous service is required, when dry batteries only are at hand.

At present I am using a lamp which I have made of a soap box of suitable size for holding an 8x10 ruby glass, in which I have two miniature lamps, and two snap switches on outside of box, one for each lamp, so that if one lamp should happen to burn out while at work I can use the other; or I can use both, if desired. The switchboard can be attached to back of lamp box if necessary. Many an amateur dreads the work in a dark room, especially



Wiring of Dry Batteries for Ruby Lamp.

in hot weather, with the oil lamp, which adds to his discomfort.

Contributed by VICTOR A. SCHYE.

L. John Block of Cincinnati, Ohio, writes as follows:

"I must say the *'Electrical Experimenter'* is some Magazine. The best ever in my opinion."

FIRST PRIZE $3.00.

SIMPLE ELECTRIC DRAWER-LOCK AND TELL-TALE SIGNAL.

The following is the description of an electric lock and tell-tale signal which I constructed for use in my workshop and have used for some time.

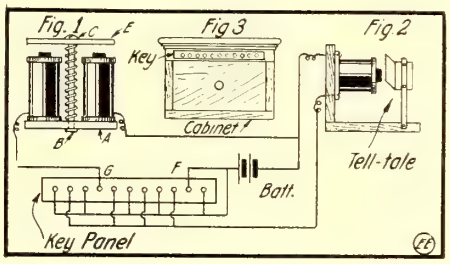
Looking at Fig. 1, A represents two magnets (I used some from bells) with the yoke drilled at B for a 1½x$\frac{3}{16}$-inch roundhead stove bolt C, which is fastened at bottom side of magnet by a nut.

A light spring D with the nut at top of bolt holds a piece of ⅛-inch iron E away from magnets until the current magnetizes and draws the iron down, thereby unlocking the drawer.

Having finished the lock, we may now turn our attention to the key, or secret switch, which unlocks the drawer. On the top part of the drawer place a thin strip of wood with brass upholstery tacks mounted and wired as shown.

By looking at the diagram it will be seen that in order to open the drawer a connection has got to be made between F and G, as all other wires connect with the tell-tale signal shown in Fig. 2.

This is merely a single magnet mounted on a strip of wood with a small piece of



Magnetic Lock and Tell-tale for Drawers.

light iron mounted on a stick which is hinged on the bottom so that the current will draw the iron strip onto the magnet. This magnet I have enclosed, together with two dry cells, in a box and placed behind the cabinet so that if a stranger opened the drawer he could not reset the signal.

This device has given excellent service, besides saving me the price of an expensive lock and, although it has been in use for a long time, both signal and lock are in good condition. Contributed by

GEORGE H. ROBERTS.

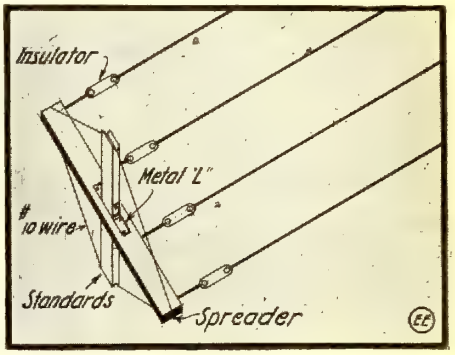
STATIC ELECTRICITY FROM SUIT CASE.

I thought I would tell you of a strange experiment in static electricity I have made accidentally. I have a leather suit case which I carry around daily. I have noticed while walking, if I brought my finger close to the suit case brass lock I felt a slight twinge. For a long while I wondered what the cause of this was. Finally I arrived at the conclusion that the suit case continually rubbing against my woolen coat caused a charge of static electricity, which stored itself in the lock. Then when the finger was brought close to the lock it discharged itself into the body, and thence into the ground. E. CAPILLON.

THIRD PRIZE $1.00.

BRACE FOR AERIAL SPREADERS.

The illustration shows the method I use to prevent my 12-foot spreaders from warping. Two wooden standards one foot long are screwed to the center of the spreader, over which is drawn a No. 10



Aerial Spreader Strengthening.

copper wire. I have been using such an arrangement for a year with perfect satisfaction.

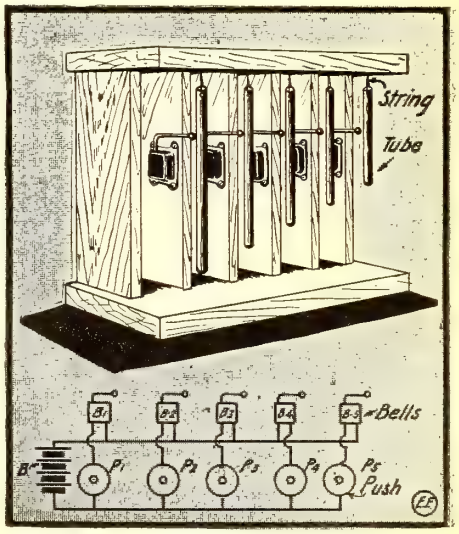
Contributed by

ARTHUR R. DARLING.

A SIMPLE ELECTRIC CHIME.

A simple but harmonic electric chime can be made by anyone. The following material will be needed in constructing this simple chime: Two pieces of oak, 12x5x¾ inches; 10 strips of white wood, 8x2x½ inches; 10 electric bells, with gongs removed; 10 pushbuttons, 10 brass tubes, ¾-inch in diameter; the largest tube should be 7 inches long and the smallest tube 2 inches long, while the other tubes should vary in ½-inch lengths.

Arrange the apparatus as shown in figure.



An Electric Chime.

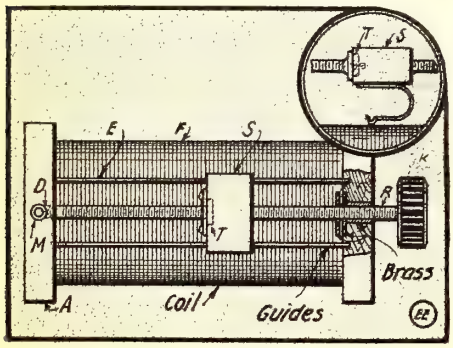
Care should be taken to allow the brass tubes to swing freely, as the tone of the tubes depends upon the vibrations received from the striking of the clapper. The connections are shown in sketch. The tubes are best hung on strings.

A PRECISION TUNING INDUCTANCE.

When it is desired to tune finely a certain circuit the knob K is turned, and also the threaded rod turns. Because it is fixed and cannot move, the nut T (and consequently the slider S) is moved up and down the coil at will. It is recommended that as coarse a pitch or spiral as possible be used, of the type used in automatic drills, etc. Thus the maximum of movement of the slider is obtained by minimum movement of the knob.

The rod R, being pivoted in D, makes contact therewith. The bolt M of binding post completes the connection.

A double or triple slide coil may be operated in this manner by reducing the dimensions (diameter) of rods R and E E, and of slider S.



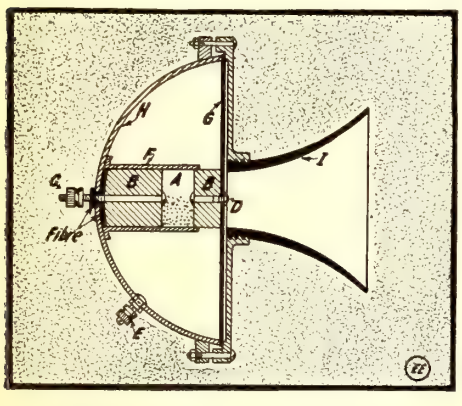
Finely Adjustable Tuning Coil.

The whole coil may be enclosed by thin wooden sides. It then presents a very neat appearance. No iron should be used in the construction of this tuner. Contributed by

A. D. R. FRASER.

MAKING A TELEPHONE TRANSMITTER.

The diagram shows how I made a simple telephone transmitter. H, the case, is a gong from an old bell; B. B are two pieces of carbon cut from an old battery, each having a hole in the center; F is a paper tube to hold the crushed carbon or better regular carbon granules A. D is a binding post to hold the carbon button to the diaphragm G, which is made of tin or ferro-type iron cut to the right size and held by a wooden ring as indicated. At C is a binding post holding the button B to the back of the gong, from which the button and post are carefully insulated. E designates a binding post attached directly to the gong and forms the other connection for the circuit. I is the mouthpiece. The diagram is self-explanatory.

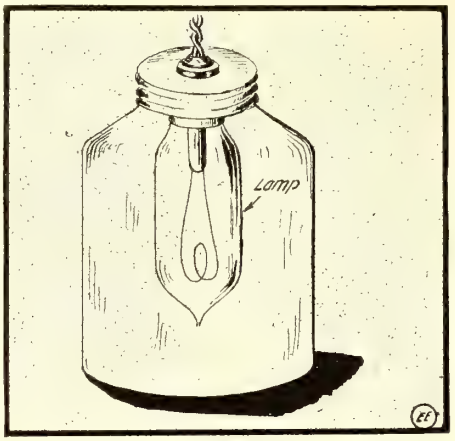


Microphone Made Out of Bell Gong.

Contributed by ALLEN SJOHOLM.

A RUGGED DARK-ROOM LAMP.

Procure an ordinary two-quart glass fruit jar, break out the porcelain lining in the cover and cut a hole through the metal just large enough to fit over the socket as shown. Then solder cover and socket together. Line the inside of the jar with two thicknesses of orange paper. One can almost use an 8-C. P. lamp, but the best is a 4-C. P. lamp. Screw the lamp into the socket and turn the cover onto the jar. With cord and plug of proper length the light can be readily moved where needed about the dark-room table.



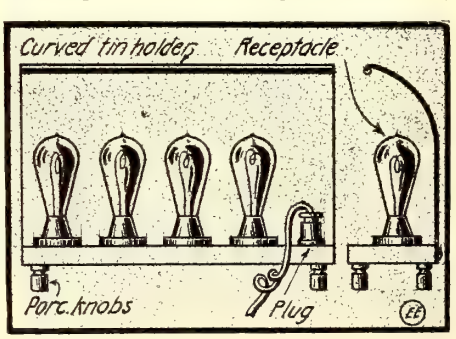
Dark Room Ruby Lamp in a Bottle. Hard to Upset.

HOW TO MAKE AN ELECTRIC HEATER.

Everyone appreciates the grateful heat and cheerful glow of the luminous electric heater or the modern open fire. It is very useful wherever a small amount of heat is desired quickly. The home-made electric heater here described is especially desirable for the sickroom, nursery and cozy corners.

Procure about 4 to 5 porcelain lamp receptacles and mount these on a hardwood base. When you mount the receptacles remember that the width between them should be large enough to allow the lamp bulbs to be screwed in and out without trouble.

Connect receptacles in parallel as shown in drawing. The last socket is left without a lamp, as this one will receive the plug. The other end of the cord has also a plug for current connection. When all is finished so far, make from sheet tin or polished copper a hood as shown in drawing. The purpose of this hood is to reflect the heat which the lamps develop. The amount of heat can be varied by using higher candle-power lamps and the heat can also be regulated by partly unscrewing some of the lamps. The more lamps there are on, the more heat, and vice versa. Porcelain knobs are best screwed under the base to act as feet in supporting the heater above the floor. If the most cheerful effect is desired frosted globes can be employed.

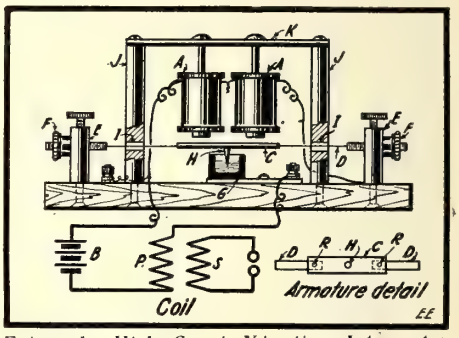


Electric Lamp Stove For the Chilly Evenings.

MAKING A HIGH SPEED INTERRUPTER.

In the accompanying drawing is shown an interrupter for producing extra high frequencies. This interrupter when properly made will interrupt circuits from 50 to 600 periods per second.

At A A are two magnets taken from an old electric bell which are supported on an iron yoke K, as shown. C is the armature, made from a piece of soft iron about No. 20 gauge. An ordinary steel pin H is riveted to the center of this armature. Two short pieces of brass spring D D are then riveted to the ends of the armature by two small rivets R R. The standards E E and J J are made of brass. Two holes I I are drilled through each standard J J. These holes are to be made large enough to let the brass springs D D vibrate freely. A small brass cup is taken from an old battery and should be fastened to the base, as shown at G. Now fill the cup about three-quarters full of mercury and connect as indicated. Any frequency may be obtained just by varying the tension of the two springs D D. Two No. 8-32 screws slip through holes in posts E, having clamping screws. Fine tension adjustment is affected by thumb-nuts F. This interrupter works very good in connection with medical wireless coils or X-ray coils.

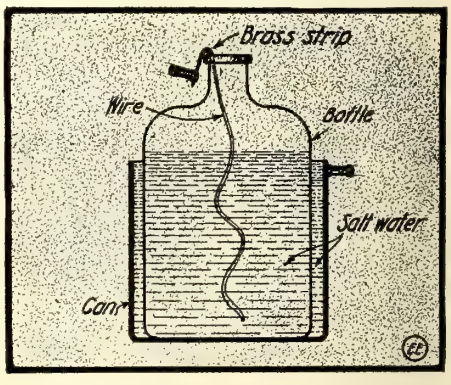


Extremely High Speed Vibrating Interrupter.

A CHEAP BUT EFFICIENT SENDING CONDENSER.

The parts needed for this condenser can be found in nearly every home. It consists of a tin can, a large bottle free from flaws, two binding posts, wire and salt water. Little need be said, as the diagram speaks for itself. The salt water acts the same as the tinfoil in Leyden jars. With one of these condensers, a 1-inch coil and no helix, I get a very good spark.

Contributed by RAY ATKINS.



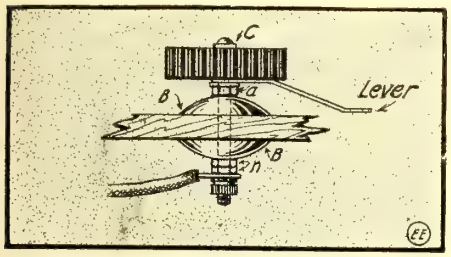
Salt Water Type Leyden Jar.

A HOME-MADE SWITCH LEVER.

An efficient switch lever for use on loose couplers inductive tuners, etc., having a much neater appearance than the ordinary lever, can be constructed cheaply in the following manner:

A brass lever is cut from a piece of sheet brass 2" long, ½" wide at one end, ⅜" wide at the other; the narrow end is rounded slightly. A ⅛" hole is bored in the wide end.

The thumb screw is made from a black checker 1¼" in diameter; the plain side is turned up and a ⅛" hole bored in its center. A stove bolt 1⅜" long and ⅛" in diameter, threaded its entire length, is slipped through the checker and the brass lever secured firmly to the bottom of the checker by the nut "a," as shown in the



Switch Construction for Tuners, Etc.

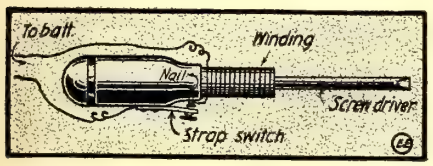
figure. A small washer had better be used, as shown at "c," to prevent the head of the bolt from pulling through the checker.

Two tin roofing caps "B," with ⅛" holes in their centers, are used to grip the surface tightly, of whatever they are attached to. Three nuts, "n,n,n," are now needed; one to tighten the bolt properly, the other for a check nut to hold the first, and the third to clamp the wire connection.

Contributed by
ARTHUR R. DARLING.

AN ELECTRO-MAGNETIC SCREW-DRIVER.

A magnetic screwdriver is very convenient in starting screws in places difficult to get at. The magnetic screwdriver herewith shown is simple to fit up. At first, wrap the steel shank with a layer of paper or tape and then wind evenly four layers of No. 24-gauge copper magnet wire,

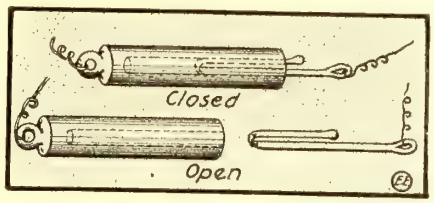


This Screwdriver Holds Screws on Its End by Magnetism.

which can be obtained in any electrical store. After the wire has been wound, make a strap key of brass or other conductive material. A small rubber knob is next placed on the end of the strap key as shown. This key is then fastened to the handle by means of brass screws. A small tack or flat-head screw is hammered on the handle in order to make the second contact. One of the wires from the coil of wire is connected to this tack, while the other wire is brought to the end of the handle. Another wire is connected to the strap key and both of these wires are braided together. These wires are taped to the handle with friction tape as shown. Every experimenter and electrician should have a screwdriver of this kind in his shop or laboratory tool kit, as a great deal of time is saved with it. The drawing is self-explanatory. A few dry cells will supply the necessary current required.

A HANDY ELECTRIC COUPLING.

A very useful electric coupling can be made from a clasp such as that used in fastening bead necklaces. They are generally made with a small ring on each half for fastening to the necklace, and the electric wire can be easily twisted around these rings. Also it is easy to make similar



Easily Made Electric Connector.

couplings for battery circuits on the style illustrated from a piece of brass tube and flat brass spring bent U shaped.

METHOD OF PREPARING LEAD PEROXIDE.

Carefully treat "red lead" with pure nitric acid ($H NO_3$). Collect the remaining substance when the acid has been poured off; wash it well and filter it carefully, drying until it is a thick paste. Now mould it into pellets in a piece of glass tube with a wooden rammer. Dry and place in detector stand. Contributed by
A. D. R. FRASER.

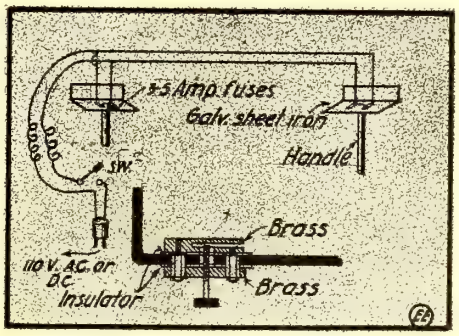
ELECTRICAL IGNITER FOR FLASHLIGHT.

As there are many photographers taking photographs where considerable quantities of flashlight powder is to be used, the following description of a very simple electric igniter may not be amiss:

As the sketch indicates, a right-angled sheet iron tray is mounted on a handle and in the center of the tray is placed two insulated brass clamps or contacts. These contacts are electrically connected to a piece of standard lamp cord, which may be joined by an attachment plug into any electric lamp socket.

Some small lead fuse wire of about 3 amperes capacity, or better, 1 ampere size, is spread across the small space, about 1 inch long, between the connection clamps.

When the current is turned on by a switch in the circuit or the key on the socket into which the cord terminal is



Electric Igniter for Photo Flash Powder.

plugged, the fuse wire is melted and ignites the flash powder.

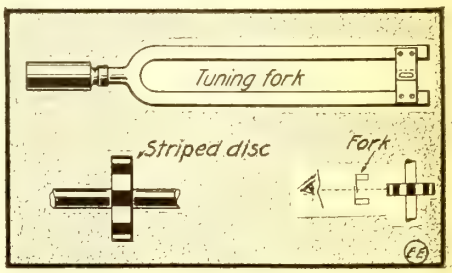
This arrangement has been used practically, with excellent results, by one of the largest commercial photographers in the country.

The New York-San Francisco telephone line is 3,390 miles long. There are two circuits, each using 6,780 miles of hard-drawn copper wire.

TUNING FORK AS SYNCHRONOSCOPE.

Probably one of the simplest ways of judging the synchronism of an A. C. induction motor, especially when the motor is of the synchronous type as used in talking picture machines, is here described.

This consists simply of a large tuning fork about 1 foot long, which is struck smartly on the hand, and at the two free ends of the fork two metal leaves pass each other in a vibratory manner. In these two leaves there are two slots about ⅜ inch long by 1/32 inch wide. To check the motor speed, which motor, by the way, has a rotating disc on the shaft painted alternately with black and white stripes about ½ inch wide, as shown in illustration, this



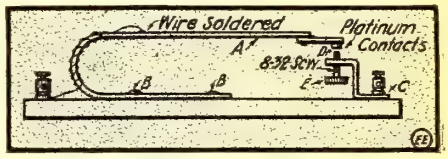
Tuning Fork Forms Simple Synchronoscope.

disc is viewed through the vibrating slits just mentioned. If the motor is in perfect synchronism with the A. C. supply and with the generator at the other end of the line, the stripes on the rotating disc appear to be stationary. If the motor is running faster than it should the disc appears to drift forward. If it is running too slow the rotating striped disc appears to move backward, or vice versa, depending upon the direction of rotation of the motor.

Of course the tuning fork used must be of the proper vibration note, corresponding to the frequency of the motor current, or rather the synchronous speed of the motor and the number of stripes on the disc. Any physics book gives these frequency equivalents.

A SIMPLE ELECTRIC FLASHER.

Here is a simple and cheap flasher for



A Thermostatic Electric Flasher.

use on battery circuits, for flashing small battery lamps or any other purpose that may suggest itself to the experimenter.

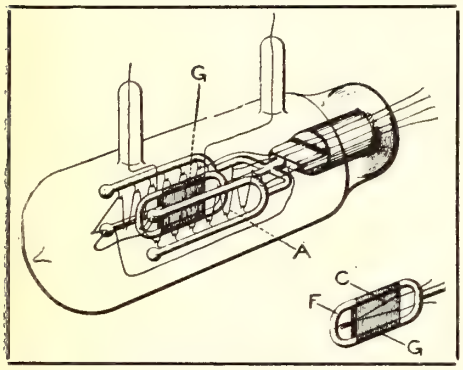
At A is a piece of steel ½x⅛x8 inches; B are two wood screws; C is a piece of brass; D, platinum contacts, and E, a set screw for adjusting this device. The winding is composed of about 8 feet of No. 36 single silk-covered wire. One end is connected to the binding post and the other end soldered to the spring, as shown.

When more than about 1½ amperes flow through the fine winding the latter heats up and causes the spring to bend so as to break the circuit at the contacts. When it cools off the spring straightens out again and closes the circuit.

This opening and closing action repeats itself every few seconds when the apparatus is properly adjusted. Different sizes of part A, and also the wire used, should be tried for various requirements until the best results are obtained.

PURE ELECTRON DISCHARGE FOR WIRELESS TELEGRAPHY AND TELEPHONY.

The electron emission from heated metals at very low pressure has been investigated by scientists for many years, and the observations have been generally explained to be the result of chemical reactions with slight traces of gas. In the first half of an article by Dr. Irving Langmuir, and which is arranged in the form of a historical review, are related the experiments leading to the conclusion of the existence of pure electron emission in even the highest attainable vacua. After outlining the fundamental principles which govern this phenomenon the author shows how, through the medium of the *kenotron* (a hot-filament vacuum rectifier) and the *pliotron* (a new type of amplifier), both of which employ the pure electron emission from heated metals in extremely high vacua, a very simple and successful equipment has been produced to send and receive radio-telegraphic and radio-telephonic messages by trigger control of the tube. As much as 2 k.w. can be controlled in this way by an ordinary microphone.



The New "Pliotron" Vacuum Bulb Rectifier For Wireless Work.

In the construction of *pliotrons* it has been found desirable to make the wires constituting the grid of as small cross-section as possible. In this way, even when a positive potential is applied to the grid, the current that flows to the grid may be made extremely small. The use of very fine wire is made possible by using a frame of glass, metal or other suitable material to support the grid. Thus, in figure, the filament G is mounted in the center of a frame made of glass rods, on which the fine grid wire is wound by means of a lathe. The grid may thus consist of tungsten wires of a diameter as small as 0.01 mm., and these may be spaced as close as 100 turns per centimeter, or even more. —*General Electric Review.*

SPEED OF WIRELESS.

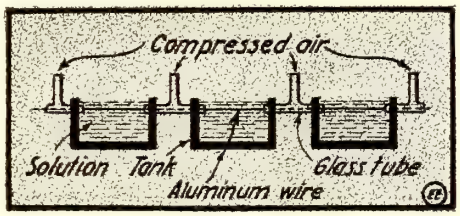
A paper presented before the French Academy of Sciences on the speed of propagation of the waves used in wireless telegraphy over the surface of the earth. The method used is as follows: Station 1 emits a signal to which Station 2 replies by a second signal. In Station 1 the time T_1 is measured between the departure of the first signal and the arrival of the second, and in Station 2 the time T_2 is measured between the reception of the first and the emission of the second signal. The time $T_1 - T_2$ is the time of transmission of the first signal from 1 to 2 and of the return signal from 2 to 1. The time $T_1 - T_2$ are measured by means of photographic microgalvanometers. By this method it is possible to measure the interval of time with an absolute precision which may become 0.00001 second. The wireless-telegraph waves are propagated over the surface of the earth with a speed apparently slightly less than the speed of light.—*Electrical World.*

ELECTROLYTIC INSULATION OF ALUMINUM WIRE.

An interesting use of the oxide film always present on aluminum wire and methods of artificially building up this film, which serves as an electric insulator, is described by C. E. Skinner and L. W. Chubb.

Numerous kinds of electrolytic baths were tried by the authors of the paper, and considerable practical results obtained. The film insulation, even after being built up, as explained, is very thin, and thus a considerable saving in the space factor is possible.

In the subsequent development continuous methods were employed in which the wire as an anode was drawn through a bath of electrolyte. In all the earlier methods of treating the wire passed over several sheaves with the result that it became hardened in the process. A straight-through method, as shown in the figure, was, therefore, tried and found to give very satisfactory results. Five tanks arranged in a straight line were used. The first and last contained hot water for washing and the middle three electrolyte. The wire passed from tank to tank through glass tubes and the solutions were kept apart by blowing air through a tube sealed to the center of the connecting tubes. In this method there was again no column of electrolyte at the point of entrance, and it was at first necessary to form the coating in two steps of 200 and 400 volts respectively. This was superseded by the present method in which the wire also goes straight through and the increase in voltage is again established through a small weir and spout through which the wire enters. This latest apparatus has the additional advantage of allowing the removal and starting of the wire without threading through.—*The Electrician,* London.



Method of Insulating Aluminum Wire Electrolytically.

ELECTROLYTIC PRODUCTION OF OXYGEN.

Several factories in St. Louis are now engaged in the electrolytic production of the commercial oxygen gas. According to the *"Engineer"* the electrolyte used is a 10 or 15 per cent. solution of either caustic soda or caustic potash. As direct current traverses the electrolyte the oxygen given off at one electrode is collected and compressed, while the hydrogen given off at the other electrode is allowed to escape. In one well-equipped oxygen factory in St. Louis it is claimed that the oxygen company can produce about three cubic feet of oxygen gas for each kilowatt-hour used.

GALVANIC CELL WHICH REVERSES ITS POLARITY.

When two plates—one of zinc and the other of tinned copper coated on one surface with selenium and varnished with enamel over the remainder of its surface—are immersed in tap water the electric current through a galvanometer connected to the plates shows that in the dark the zinc is electro-positive to the selenium, while the result of light falling on the selenium is to increase the effect, says A. A. Campbell-Swinton in *The Electrician,* London. If, however, instead of zinc, carbon or copper is employed for the non-coated plate, the interesting result is obtained that, while the selenium proves to be electro-positive to the carbon or copper in the dark, it immediately becomes electro-negative to carbon or to copper when it is illuminated, this being easily shown by the deflections of the galvanometer in contrary directions as the light is turned on and off.

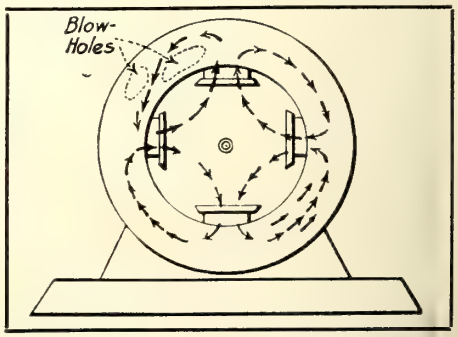
SLOW CATHODE RAYS.

In a recent lecture by Sir J. J. Thomson, at the Royal Institution, London, the electron discharge at different voltages, in a Coolidge type evacuated bulb were described. A curve was given which showed the relation between the voltage applied and the number of negative electrons radiated. The curve and also the experiments made, indicated that at least 15 volts was necessary to produce any appreciable radiation.—*The Electrician,* London.

A horse is very sensitive to electrical shocks and nearly always succumbs to 550 volt current. About 1,800 volts is required to kill a man ordinarily in the electric chair.

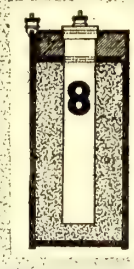
X-RAY TO LOCATE CAUSE OF BRUSH TROUBLES.

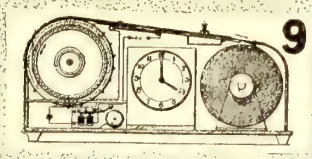
In electrical machines with cast iron or steel frames blow-holes may be present and may be large enough to increase greatly the reluctance of a section of the magnetic circuit. The reluctance being higher in one section of the circuit than in others will cause a lower voltage to be developed in a corresponding section of the armature, and local circulating currents will result. The blow-holes being concealed, it has often been found quite difficult to determine definitely whether or not they are the real cause of the trouble. According to E. H. Martindale, of the National Carbon Company, says *Electrical World,* steps are now being taken to use X-ray machines to search for blow-holes in machine castings whenever it is suspected that high reluctance in the magnetic circuit is causing brush trouble.

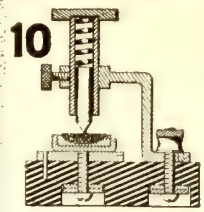


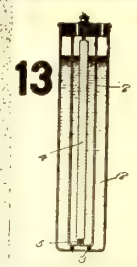
X-Rays Show up Blow Holes in Dynamo Castings.











A Brief Digest of the Latest Electrical Patents

LAMINATED IRON CORE (Fig. 1)—An arrangement of iron laminations in cores, making joints come in proper relation to magnetic flux path.

AUTOMATIC FIRE ALARM (Fig. 2)—A simple method to notify "Central" when a fire occurs at a subscriber's house. A fusible strip supports the receiver bracket, as shown.

TELEPHONE REPEATER (Fig. 3)—Improved form of telephone relay acting differentially. The magnet coil attracts armature, joined by levers to double action microphone.

ELECTRIC LOCOMOTIVE (Fig. 4)—This patent relates to the support of powerful electric motors above locomotive driving wheels, as shown, similar to the Pennsylvania Railroad type.

ELECTROLYTIC INTERRUPTER (Fig. 5)—Improvement in electrolytic interrupter consisting of one or more anodes, projecting upward as seen, in the bottom of the electrolyte container. Cathode enters at the top of container. This idea allows the gas bubbles to arise freely from the anodes.

SPARK-PLUG TROUBLE DETECTOR (Fig. 6)—A device to be used on motor cars, etc., connected in the sparking circuits, so that each spark may be observed as it passes through this series detector.

MAGNETIC VALVE (Fig. 7)—An electro-magnet is arranged to operate steam, gas or water valve, as shown, and also is provided with switch attachment, etc., for closing and opening circuit.

DRY CELL (Fig. 8)—Improvement in dry cell manufacture by which a rigid disc is placed tightly in the upper portion of cell against the mixture in order to retain same firmly.

ELECTRIC APPOINTMENT ANNOUNCER (Fig. 9)—A novel appointment announcer which operates by means of perforated paper strips, a clock, together with electric bell and battery.

RADIO DETECTOR (Fig. 10)—New "Pickard" detector, covering particularly the adjustment of contact point on mineral. Several movements are possible for the point.

ATTACHMENT FOR TELEPHONE TRANSMITTER (Fig. 11)—A hinged cover is provided for use on telephone transmitter mouthpieces, presumably to keep the dust out, etc.

MAGNETIC SEPARATOR (Fig. 12)—Useful form of magnetic separator for removing iron filings from brass, etc. Brass sleeve (4) can be slid down by handle (6) so as to throw off iron after it has been attracted.

STORAGE BATTERY (Fig. 13)—Comprises an outer shell with zinc amalgam on the inner surface, constituting a negative electrode; also inner shell having an outer surface of copper amalgam for the positive electrode. Inner surface of inner shell is zinc amalgam with lead plate within it, constituting the negative electrode.

MAGNETIC CLUTCH FOR SHAFTS (Fig. 14)—Strong magnet coil controllable from switch and battery, etc., causes two parts of clutch to be held together magnetically and vice versa.

ELECTRIC HORN (Fig. 15)—Diaphragm is vibrated by means of tooth on center of same, coming in contact mechanically with revolving toothed armature of electric motor, as seen.

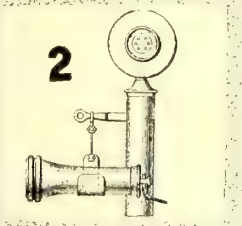
ELECTRO-PNEUMATIC HORN (Fig. 16)—A clever combination of electric and pneumatic horn, which is very compact. Can be actuated either by air bulb or electric button.

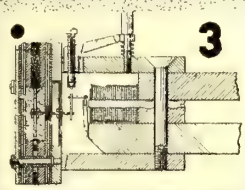
ELECTRIC WATER FOUNTAIN (Fig. 17)—Water fountain, having electric pump to circulate water through nozzle, etc., and also provided with electric lamp in center of water for illuminating effects.

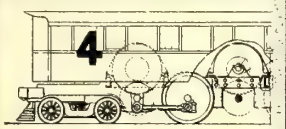
OSCILLATING FAN (Fig. 18)—Improved form of oscillating electric fan. Fan motor has gear attachment to cause same to be mechanically oscillated to and fro, in the usual manner.

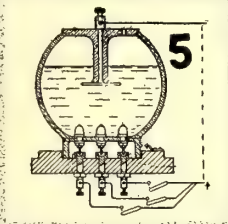
TELEGRAPH KEY (Fig. 19)—Vibrating form of speed telegraph key arranged to automatically close the circuit for certain length of time, as for dots and dashes.

(Copies of any of the above patents will be supplied at 10c. each by the publishers.)

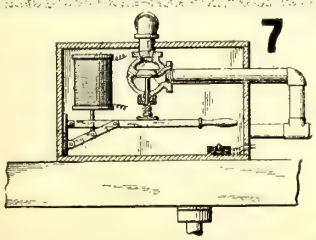


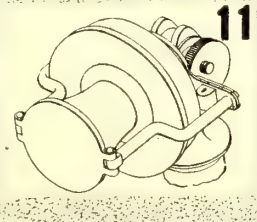


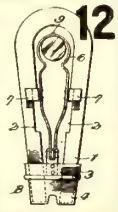


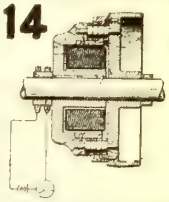


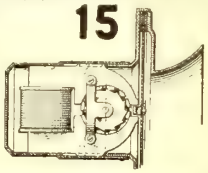


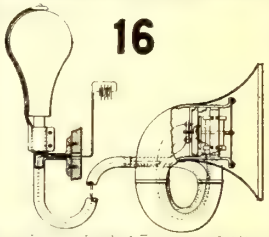


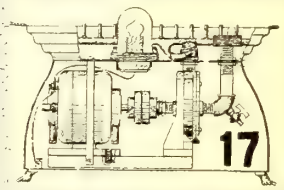


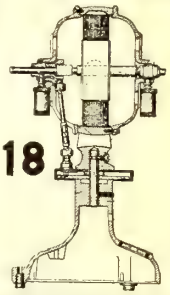


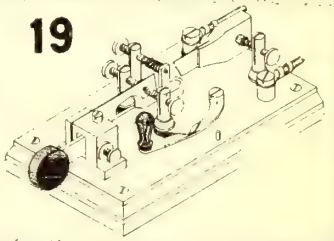












AMONG THE AMATEURS

AMATEUR RADIO STATION CONTEST.

Monthly Prize, $3.00.

This month's prize winner.

HENDRIX LABORATORY.

I am a regular reader of *The Electrical Experimenter,* and as I have made my wireless set what it is by reading this paper I would like to see a picture of my station in it. My aerial is 150 feet long, 105 feet above the ground at one end and 90 feet high at the other end. I have seven strands of solid copper wire No. 12 on 12-foot spreaders. The ground is a 12-foot galvanized iron pipe driven 11 feet into the ground.

My receiving set is composed of loading coil, loose coupler which tunes to about 2,500 meters, a rotary variable condenser in the primary circuit of the loose coupler, and a tubular variable condenser in the secondary circuit. I have two pairs of 'phones, one pair of 3,000 ohms and one pair of 2,000 ohms; potentiometer for electrolytic detector; also E. I. Co. Radioson, Ferron, Turney crystaloi, galena and perikon detectors. These are arranged on a six-point switch. I have a fixed blocking condenser with switches for adjustment, and a fixed condenser with switch across 'phones. A buzzer test is also included in the set, which incorporates a common buzzer, an amplifier and battery and push-button. A single slide tuning coil is also shown in the picture, which, by means of



Mr. Hiram Hendrix Receiving Arlington Time Signals Via Radio.

a switch, may be thrown in as an extra loading coil.

Here is a list of a few of the stations which I receive from: N. A. A., Arlington, comes in very strong; N. A. R., Key West, comes in quite strong; I. W. C. O., Springfield, Ill., quite strong. I also get Tuckerton, Sayville and Colon sometimes on exceptionally good nights. *I would like to exchange photos of wireless sets with other amateurs.*

HIRAM HENDRIX.

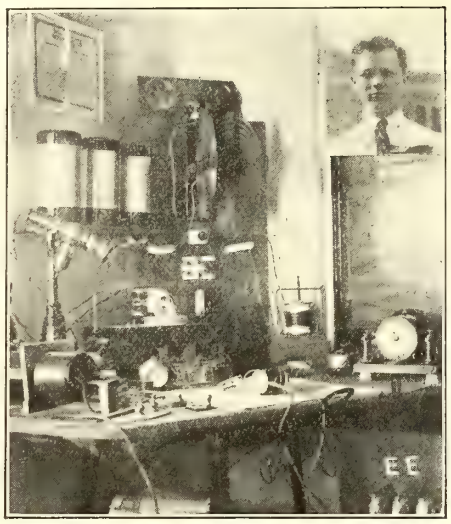
Wellsboro, Pa.

PHIL SCHMITT'S RADIO EQUIPMENT.

I am sending you a picture of my radio set. My transformer is ¼-K. V. A. I am using a quenched and rotary gap. The oscillation transformer is of Telefunken type. Almost all the instruments are my own make and style, made mostly from E. I. Co. goods. For an aerial I am using one wire about 500 feet long and 60 feet high. I am getting excellent results with it. The station is located in my bedroom, and the first and last thing when getting up or going to bed is to sit down and listen in or flash off a few "good mornings" or "good nights" to my radio chums. I have been a reader of *The Electrical Experimenter* ever since its first issue and it has been a great help for my experimental work.

PHIL SCHMITT.

New York City.



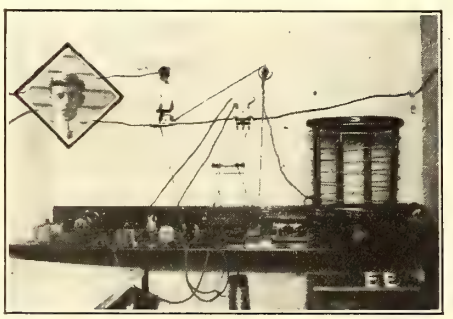
Phil Schmitt and His Excellent Wireless Equipment.

PARK SNYDERS RADIO STATION.

The transmitting set of my radio station consists of the following instruments: One-inch spark coil, wireless key, a large aluminum wire helix, two 1-quart Leyden jars and spark gap. The helix and the Leyden jars are home-made and the other instruments are factory-made.

My receiving set is composed of an Amco loose coupler, home-made loading coil, Brandes' 2,000 ohm head set, an E. I. Co. Universal mineral detector and a cat-whisker defector, a fixed condenser and a Murdock rotary variable condenser.

The aerial is 50 feet high at one end and 40 feet high at the other end, and is 85 feet long. It is supported at both ends by iron masts made of 1 and 2-inch pipes and is braced every 20 feet by three guy-wires. The aerial proper consists of four No. 14 aluminum wires, each 85 feet long and spaced 2 feet apart on 6-foot spreaders. These four wires are connected together at both ends. My lead-in is a No. 4 rubber insulated copper wire and is 20 feet long. This wire runs from the aerial to the



Park Snyder and His Wireless Transmitting and Receiving Set.

ground switch and from there a No. 14 copper wire runs to my instruments. I use two of the wires for sending and all four of them for receiving.

On the wall is seen my aerial switch and also a line switch. With this set I have no trouble in "talking" with other operators who live within a radius of 10 miles. I have had very good results in long distance receiving work and I hope to have better luck soon, as I am going to add another loose coupler and variable condenser to my set.

PARK SNYDER.

Connersville, Ind.

THE LEHIGH WIRELESS ASSOCIATION.

The Lehigh Wireless Association, with headquarters at Allentown, Pa., was organized Oct. 2, 1914. About a month ago the following officers were elected:

Earl Back, president; James Gardner, vice-president; Arthur Lentz, treasurer; Arthur C. Jacoby, secretary.

Almost all the members of the association have up-to-date transmitting and receiving sets and are also licensed operators. Meetings are held weekly at the home of the president.

The association has a 1-K.W. transmitting set, which can transmit about 100 miles, and messages have been received from NAR, NAU, NAW and WCC, and would like to communicate with other wireless associations. All communications are to be addressed to Arthur C. Jacoby, secretary, 517 Linden street, Allentown, Pa.

WIRELESS SET OF ARTHUR JACOBY.

Herewith is a flashlight photograph of my wireless station. Although I am not a



Arthur J. Jacoby and His Well Finished Radio Set.

subscriber I get the magazine every month in town. My aerial is 100 feet long, 70 feet high at one end and about 40 feet at the other end, composed of four strands of wire.

The station is equipped with a complete receiving and sending set. The receiving set consists of a loose coupler, two loading coils, three detectors, galena, perikon and crystaloi, one variable condenser, fixed condenser and a pair of 2,000-ohm 'phones.

The sending set consists of 1-inch spark coil, condenser, helix, spark gap and key, and can transmit about five miles. The station has a small switch-board with all the instruments wired to it.

The station has a receiving range of 1,000 to 1,500 miles day and night.

ARTHUR C. JACOBY.

Allentown, Pa.

ALBERT MEDAL TO MARCONI.

The Albert medal of the Royal Society of Arts, London, was recently presented to William Marconi. The medal was instituted in 1863, when the Prince Consort was president of the society. The medal is awarded annually for "distinguished merit in promoting arts, manufactures and commerce."

Phoney Patents

Under this heading we will publish hereafter electrical or mechanical ideas which our clever inventors, for reasons best known to themselves, have as yet not patented. We furthermore announce the grand opening of the

PHONEY PATENT OFFIZZ

For the relief of all suffering daffy inventors in this country as well as the entire universe.
We will revolutionize the Patent business immmediately and OFFER YOU THREE DOLLARS ($3.00) FOR THE BEST PATENT. If you take your Phoney Patent to Washington, they charge you $20.00 for the initial fee and then you haven't a smell of the Patent yet. After they have allowed the Patent, you must pay another $20.00 as a final fee. That's $40.00 ! ! WE PAY YOU $3.00 and grant you a Phoney Patent in the bargain, so you save $43.00 ! ! When sending in your Phoney Patent application, be sure that it is as daffy as a lovesick bat. The daffier, the better. Simple sketches and a short description will help our staff of examiners to issue a Phoney Patent on your invention in a jiffy.

PHONEY PATENT OFFIZZ

ANANIAS GASBLOWER OF CHAUTOKA

STRETCHMOTOR

No. 0009¼ **Potented June 63, 1915**

Specification of Phoney Patent
Application fired November 39th, 1769

TO ALL WHOM IT DOES NOT CONCERN:

Be it known that I, Ananias Gasblower, a resident of Chautoka, in the county of Ishkabibble, in the state of Wis., have invented a new and useful, revolutionizing means of conserving power, which since the beginning of the world has gone to waste.

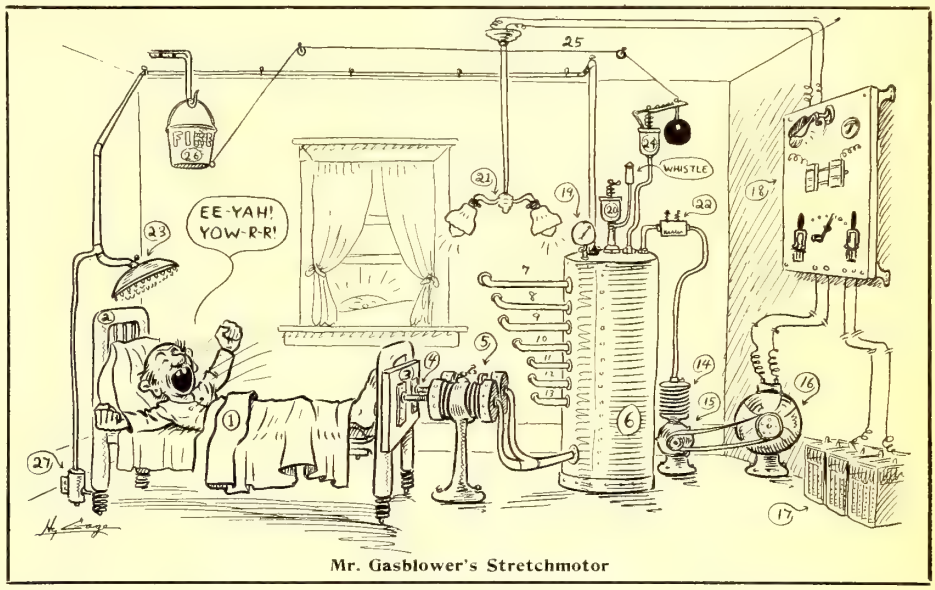
The object of this invention is to provide a means of collecting and storing the tremendous amount of power expended when man stretches himself after awakening in the morning. Up to now this power has gone to waste, but my new invention which I term the Stretchmotor, will do away with all this. It has been estimated that a full grown man giving a healthy stretch produces an average pressure at the foot of his bed of about 120 lbs. Most individuals stretch themselves from 4 to 7 times in the morning, each stretch lasting about 4 seconds. This means that a total energy is developed that could lift a weight of from 480 to 840 lbs. about 2 feet above the floor—a tremendous power. Lazy people or those fond of stretching will even do better. My calculations show that if the entire stretching power of every citizen of a town of 100,000 people could be converted and stored of only one morning, the entire city could be lighted up with electricity for 4 days, 6 hours, 12 minutes and 19 seconds.

With this object in view my invention consists essentially of an individual, a morning, a bed, an air compressor, a dynamo, a storage battery.

In the drawings which accompany and form part of this specification I have illustrated in diagram several features which embody the subject of my invention, and how the stretchmotor is operated in practice.

In the drawing (1) represents the individual, just awakening; (2) is the bed; (3) is the footboard; (4) are the connecting rods connecting the footboard with the piston of the air compressor (5); (6) is the compressed air tank in which the energy is stored; (7), (8), (9), (10), (11), (12) and (13) are pipes coming from the other bed-rooms of the house, each pipe being connected to a piston and a compressor, which in turn are attached to the other beds throughout the house. (14) Is the piston of the compressed air motor (15), which is belted to the dynamo (16), which in turn charges the storage battery (17); (18) is the switchboard and automatic cut-out; (19) is the air pressure gauge; (20) the safety valve. This safety valve has a whistle attached to it; thus if the members of the family generate too much energy the whistle will blow as a warning to all not to stretch themselves too long or too strongly. At (24) another valve is shown. This is a final emergency valve. It is technically called the Ultimatum valve. If the individual pays no heed to the sounding of the whistle and persists in stretching himself the pressure in the tank (6) may rise up to 12,000 lbs. per square inch. As soon as this happens the Ultimatum valve (24) opens, which in turn pulls down the string (25). This string runs over several pulleys to the water pail (26), which is upset thereby and its contents are poured over the individual (1), extinguishing him completely. (21) Are the electric lights, lighted from the storage battery (17). As soon as the pressure within the tank (6) reaches 6,000 lbs. per square inch, an automatic valve (22) opens and the compressed air flows in the piston (14), which operates the compressed air motor (15).

(23) Is a compressed air blast which starts automatically after the individual begins stretching. This air blast blows a strong blast of air in the individual's face, which is so disagreeable that he will get up and remain up. This discourages individuals from staying in bed once awake, and furthermore awakens them thoroughly. As soon as the occupant leaves the bed a spring (27) closes the airblast automatically.



Mr. Gasblower's Stretchmotor

In testimony whereof I have hereunto subscribed my name this 35th day of November, 1769.

ANANIAS GASBLOWER.

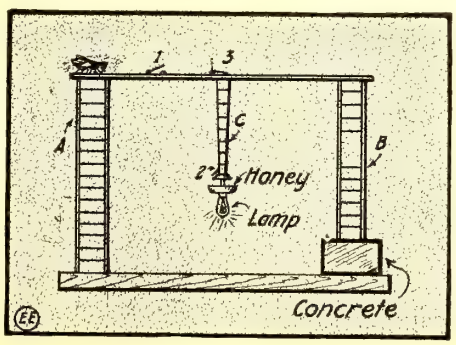
AN ELECTRIC FLY KILLER GUARANTEED TO WORK.

While there have been many electrical insect traps and annihilators perfected and patented, one of the most novel, perhaps, is described below by the aid of the sketch shown.

The inventor of this marvelous electrical "Fly Annihilator" has explained the principle of it as follows:

The fly is attracted to the device first by the odor of honey or molasses, which is placed in a small, inaccessible cup mounted over the incandescent lamp as indicated. The fly walks up the ladder "A" and along the footpath provided for his majesty at the top of the instrument.

The illustration shows the fly walking toward an electrical switch "1," and when he passes over same in his quest for the honey the electric lamp is thereby switched on. He then proceeds to climb rapidly down the ladder "C" toward the honey, guided, of course, now by the illumination from the lamp.



When he reaches the trigger switch "2" the lamp is extinguished, and at the same time a small spring-actuated barrier "3" stands up vertically, thereby effectually cutting off his retreat.

The little fly now starts to walk back up the ladder "C," and when he arrives at the top he has but one alternative, and that is to walk along the footpath and down the ladder "B" to terra firma.

Sad to relate, there are about three steps missing in the ladder "B," and before he has time to "watch his step" he is precipitated violently onto the concrete block below and dashes his brains out.

QUESTION BOX

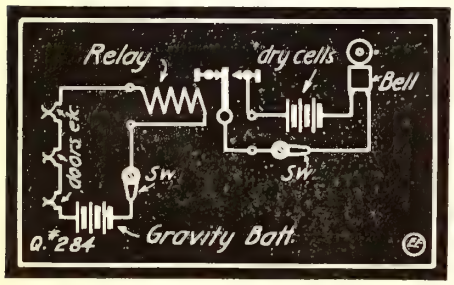
This department is for the sole benefit of the electrical experimenter. Questions will be answered here for the benefit of all, but only matter of sufficient interest will be published. Rules under which questions will be answered:

1. Only three questions can be submitted to be answered.
2. Only one side of sheet to be written on; matter must be typewritten or else written in ink, no penciled matter considered.
3. Sketches, diagrams, etc., must be on separate sheets. Questions addressed to this department cannot be answered by mail.

CLOSED CIRCUIT BURGLAR ALARMS.

(284.) Leopold M.——, Brooklyn, N. Y., asks several electric burglar alarm questions:

A. 1. You will undoubtedly have to employ a closed circuit battery, such as the gravity cell, for your particular form of burglar alarm. Diagram is given showing how this is used with a relay, and if the wire in the main circuit is cut by an intruder at a window, for instance, then the



Closed Circuit Burglar Alarm.

battery current, of course, will be cut off from the relay and the armature of same will be released by its magnets; this allows the armature to drop back against the contact screw, as will be perceived, thus closing the alarm bell circuit.

The relay in this case should have a fairly high resistance of, say, 150 ohms' value; three to four gravity or crow-foot cells will be all right for the work. Ordinary dry cells can, of course, be used in the local (open) alarm bell circuit to the number of three or four for a medium-size bell, etc.

STATUS OF PATENTED ARTICLES.

(285.) William Foerste, Pelham Manor, N. Y., inquires as to the status of patents on wireless devices as related to manufacturing, etc.:

A. 1. You can manufacture or sell wireless and electrical apparatus as you mention without obtaining any license, except instruments which are patented and already sold under a license, etc. In this case you will, of course, have to take up the matter with the owners of the patent or the company who already builds the instrument. Otherwise you are liable to get yourself into no end of trouble. We may say in this direction that from many cases which have been settled in the past of such a character it has been the rule that invariably the party making apparatus without license rights from the patent owners have had to pay all the patent royalty accruing on the total sales of such instruments for the total period during which they were manufactured prior to court action.

A. 2. We are not familiar with the details of the wireless system utilized by Mr. Eugene Dynner, of Guttenberg, N. J., but you can, of course, write to him and he will be undoubtedly glad to give information you desire.

TRANS-ATLANTIC RADIO PLANTS.

(286.) Donald Rockwell, Wellsboro, Pa., wants to know why the powerful radio station at Arlington, Va., was not shown on the map of Transatlantic radio stations published in the March *Electrical Experimenter*:

A. 1. The reason why the radio station at Arlington, Va., was not shown in the recent Transatlantic Radio Map was due to the fact that Arlington is not considered, in the ordinary sense, a Transatlantic wireless station. While the signals from Arlington have been heard across the ocean it does not do this work regularly, as is the case with the German stations at Tuckerton, N. J., and Sayville, L. I.

We have no data on the operating range of the radio station at Colon, Panama, but it has been heard in New York City a great number of times by experimental wireless stations.

Want to Swap?

If you have anything to buy, sell or exchange and want to make sure of doing it quickly and at an insignificant cost advertise in the

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OF
The Electrical Experimenter

You will find advertised in these columns:

Photographic supplies, Phonographs, Wireless Apparatus, Electrical goods, Bicycles, Motorcycles, Rifles, Gasoline Engines, Microscopes, Books, Skates, Typewriters, Etc.

The owners of these things wish to ***"swap"*** them for **something else, something which you may have.**

The Rates

One cent per word (name and address to be counted) minimum space 3 lines. Average 7 words agate to the line. *Remittance must accompany all orders.*

The Classified Columns of the ELECTRICAL EXPERIMENTER GET RESULTS

More than 35,000 Electrical Experimenters will see your ad.

STORAGE BATTERY TROUBLE.

(287.) Fred Taylor, Norfolk, Conn., says his storage battery will not hold a charge for any length of time and wants advice on his probable trouble:

A. 1. We do not know what your battery trouble may be, but possibly the cells need washing out thoroughly, as there may be some collection of sediment on the bottom of the jars. In this case the electrolyte should be poured out of the jars and they can then be filled with clean water and flushed out several times, till the water flows clean. The electrolyte should then be strained through a piece of fine cloth and replaced in the battery. Add distilled water to bring its specific gravity to proper point if high in density. Also add distilled water only in filling up cells to cover plates when exposed by evaporation of water in electrolyte.

In some cases the battery plates become covered with a white coating known as sulphate. If you are having trouble of this character the following directions for sulphation treatment will probably be of service.

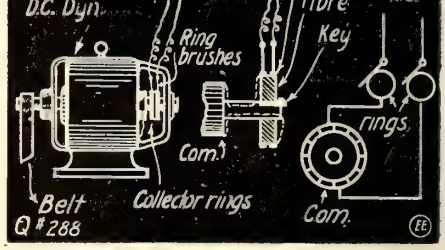
For sulphation treatment charge the battery as rapidly as it is possible to send current into it without overheating. The resistance being greatly increased by the effect of the sulphate, the cell will become hot when charging. Use a thermometer in the electrolyte to test the temperature and maintain the current at such a value that the temperature of the cell does not exceed 110 degrees F. Continue this charge until the plates begin to gas freely, then reduce the rate of charge to the eight-hour rate and continue this until the plates again begin giving off gas. The rate of charge should then be reduced to half the eight-hour rate and continued until further gassing again occurs. The cell should then be partly discharged and the treatment repeated. This cycle of operation may have to be carried on for some time, but should be continued until the negative plates show at least 0.10 volts between a cadmium electrode and the negative plate, the cadmium being positive to the negative.

ALTERNATING CURRENT FROM D. C. DYNAMO.

(288) G. L. La P., Iowa, wishes to use some form of mechanical interrupter on his 110-volt D. C. dynamo circuit (3 K.W.) instead of an electrolytic interrupter, for operating his wireless set.

A. 1. We do not know anything to suggest in the matter of operating a couple of ½ K.W. transformer coils on 110-volt D. C. circuit with some form of mechanical interrupter. We would further advise that it is not generally satisfactory to use a mechanical interrupter for 110-volt circuits in the way you propose.

A suggestion for you in this direction,



A. C. From D. C. Dynamo.

and we believe you would find it the best of all, is cited below; besides, this would enable you to use a rotary spark gap of the synchronous type.

The sketch depicts this suggestion in detail, and it simply consists of placing two brass collectors on your dynamo shaft, with two brushes placed in contact with the rings, from which to take alternating current. These two rings are connected to

diametrically opposite commutator segments, as the diagram shows, and you can in this way obtain about 75 to 80 volts alternating current, if your direct-current dynamo rating is 110 volts.

The dynamo is driven in the regular way by belt, and also you can arrange your rotary spark-gap disc or arm on the end of the shaft by extending same, if necessary, and you will then have a synchronous spark-gap outfit similar to the Fessenden style commercial sets.

With this arrangement you may use a closed-core wireless-type transformer, etc., or you might make up an open-core transformer from three ½-K.W. transformer coils.

Instead of the rotary gap you can also very readily employ a quenched spark gap. We presume your D. C. dynamo is a two-pole machine, and you will then get in the neighborhood of 60 cycles frequency A. C. with the armature running at 3,600 R. P. M.

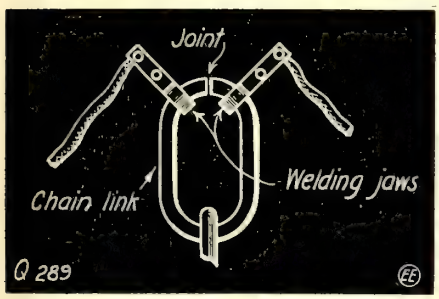
The commutator is left the same as it now is, and if you desire to take A. C. only from the machine, and if there is not sufficient room to place the collector rings and their fiber drum between the commutator and the bearings, you might arrange to mount this drum and rings on top of the commutator. A local machinist can do this for you at small expense.

Another scheme in this direction is to mount the collector-ring drum on the outer end of the shaft beyond the bearing, and to bring the two wires to the collector rings from the commutator through a small hole bored through the center of the armature shaft, as the sketch shows.

ELECTRIC "CHAIN" WELDING.

(289) John Burkett, Madoc, Ont., Can., asks several questions.

A. 1. There have been no recent developments in the use of iron cores for high-frequency tuning coils, etc., and the reason why they are not used for this purpose is due to the fact that the iron tends to lag behind the magnetizing current in its magnetic reversals of polarity, etc. This creates a very bad power-factor and occasions, therefore, considerable losses in the coil.



How Chain Links Are Welded Electrically.

A. 2. Answering your second question regarding the welding of wire fencing and chain links, etc., by electricity, would say that this takes place on the basis that the electric current will always, of course, take the shortest or lowest-resistance path through a conductor, and you can thus see that by proper arrangement of the welding-machine jaws and contacts the shortest path for the current will, for instance, in the case of a chain link be through the joint in the link, as the sketch herewith shows.

Special arrangements of the contact jaws of the welding machine are made use of in electric fence welding.


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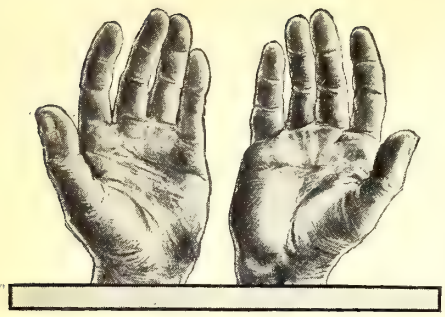
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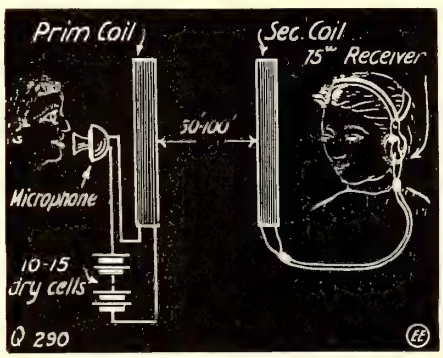
The theory of this work is that the electric current will always, as aforesaid, take the path of least resistance through a conductor, and as the greatest amount of current will thus pass through the shortest part of the chain link, for example, it is patent that this part of the circuit will become the hottest and will thus be welded electrically, as the heating effect in a circuit is due to the value of the current in amperes, squared, multiplied by the resistance in the circuit in ohms.

INDUCTIVE SYSTEM RADIOPHONE.

(290) Edward L. Jewett, Sullivan, N. H., inquires about building an inductive-type wireless telephone using two large coils of wires acting on each other by electro-magnetic induction.

A. 1. Regarding the inductive type of wireless telephone, would say that of course the large the coils are made, other things being equal, the better this arrangement will talk. It is, however, only adapted, generally speaking, to short-range demonstration work and the like.

The wire you mention for the coils is all right and it is well to make the receiving coil of finer wire, as suggested, as the receivers of course have a higher resistance and cannot be benefited by the heavy



Inductive Type Wireless Telephone.

current generated in a coil of large-size wire.

You are correct in assuming that it is the ampere-turns in the coils which count most; but of course the various parts of the circuits should be properly related to each other in any case. This matter is fully discussed in H. Gernsback's 25-cent book, "The Wireless Telephone," supplied by our book department.

RADIO QUESTIONS.

(291) L. B. Wilcox, Angola, Ind., asks us several wireless questions on spark gaps, etc.

A. 1. The rotary spark gap you mention should be all right. To properly break the detector circuit with break-in system, as you mention, the detector should be short-circuited by means of automatic switch or by extra contacts on the transmitting key, whenever the transmitting set is excited.

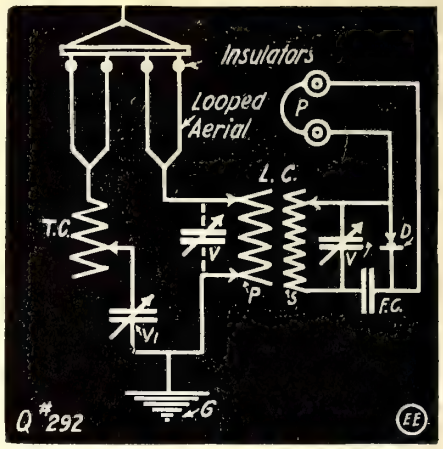
We do not recommend an iron-filings refer you to the February, 1915, *Electrical Experimenter*, wherein you will find curves given for reading wave lengths direct.

We do not recommend an iron-fillings core for your transformer, but a sheet-iron or an iron-wire one will prove superior, we believe.

The wireless station at Key West, Fla., sends time signals and weather reports via radio at noon, Eastern time.

VARIABLE CONDENSER CONNECTION.

(292) Austin Hewes, Crete, Ill., wants to know how to hook up a variable condenser to his radio receiving set, and he



Looped Aerial Connections.

also complains of severe static signals in his 'phones.

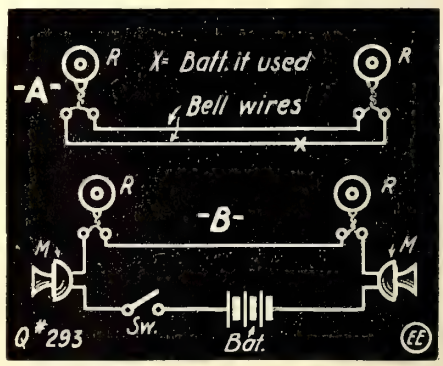
A. 1. The variable condenser may be connected across the secondary of the loose coupler. The diagram here shown has been used by several of the commercial radio companies and you will find this arrangement will enable you to tune out a great deal of static, etc., through the static tuning loop, comprising a tuning coil T.C. and variable condenser V_1, as observed.

SERIES TELEPHONE.

(293) H. J. Brown, Cleveland, O., writes us regarding the use of two 75-ohm telephone receivers on a bell circuit for telephone purposes.

A. 1. We give you herewith diagram (at "A") showing you how to use a couple of telephone receivers of the 75-ohm type for carrying on conversation over a bell wire circuit, etc.

It sometimes improves matters a great deal to connect a couple of dry batteries in the circuit, and you will vastly improve the efficiency of this arrangement if you connect in a couple of regular microphones



Series Telephone Hook-Up.

"M." You will then have what regularly constitutes a series telephone circuit, capable of talking over a number of miles. The battery should be cut out when through talking by a switch.

Note: On July 1 the subscription price of THE ELECTRICAL EXPERIMENTER goes to $1.00. Don't fail to take advantage of the present low rate. See page 95.

PATENT ADVICE

Edited by H. GERNSBACK

Shall He Patent Detector?

(1) Alfred Smith, Waukegon, Wis., submits a drawing and plans of a wireless detector stand; he wishes to know if we advise him to apply for a patent on the instrument.

(A.) As a general rule would-be inventors of detector stands could save a lot of money and energy by not trying to patent such devices. While we do not say that a patent could not be obtained on the detector stand described by our correspondent, we certainly will say that such a patent would assuredly not be of much commercial value.

It should always be borne in mind that it is a rather simple matter to obtain a patent, but it is another thing to exploit the same patent commercially. After all, a patent is not obtained except to exploit it commercially; it is no honor to have a long list of patents that lay idle and on which much money has been expended, if such patents are not utilized commercially. In the case of the detector stand of our correspondent the article no doubt has some original points, but none of them is novel enough or strong enough that it could not be evaded by a clever constructor. There have been so many detector stands described in the current literature that it is almost impossible to find any kind of a detector movement that is novel and that could not be easily modified by anyone.

We strongly advise would-be inventors not to spend money in trying to patent detector stands or similar appliances.

"Patent Applied For."

(2) Henry Schneider, Milwaukee, Wis., asks us if he can market an article on which he has applied for patent some time ago, but on which the patent has not as yet been granted.

(A.) We strongly advise against marketing any article which has not been patented. The mere reason for applying patent does not mean anything whatsoever and affords no protection for the following reasons:

If your article, on which you have patent applied for is put on the market, and if a competitor should market a similar article it will be impossible for you to bring any action against him because you have no patent. Also, if your competitor wishes to do so he can file a patent application covering the identical article. This means that there would be in the Patent Office immediately what is technically called an *"Interference."* The Patent Office will then throw the two applications out and will let the two contestants fight the case out between themselves. This usually is quite an expensive procedure and unless the invention is quite valuable it is not feasible for the two contestants to fight it out in court. Most of the time the patent case is dropped all together, while the original inventor must either go on fighting his opponent or else allow him to manufacture the same article. Another feature is that it is impossible to foretell how soon a patent will issue even if no "Interference" is recorded at the Patent Office; your patent may not *issue* for years.

In the meanwhile a competitor could establish a growing business and while you might collect back royalties from him afterwards, if your patent is finally proven valid, it invariably means expensive law suits. Besides, if your competitor has once obtained a start it is usually very hard to stop him.

For these reasons we would advise all inventors to be very cautious and not to market an article until the patent has been granted by the Government.

Once you can show that the patent has been allowed and your label or literature is sent out with your merchandise calling attention to the patent, most people, unless they feel sure of their grounds, will not attempt to manufacture the same article. This is where a patent usually protects.

Is Switch Patentable?

(3) Alfred B. Duck, Richmond, Va., has sent in a rough sketch of a switch and wishes to know if we advise him to patent the invention.

(A.) The sketch is so rough and incomplete that it is impossible to tell just how this is supposed to work; also, the description is not clear enough for us to form an opinion of the function of the supposed invention. We would ask our correspondent to send in a better sketch and a better description.

We publish this merely as a request to inventors to make their sketches as clear as possible when sending drawings to this department. This will do away with a great deal of delay and will make it possible for this department to publish the answer at once. It should be borne in mind that this department does not answer patent questions by mail, but publishes all information of this kind for the benefit of all readers.

Search for Patentability.

(4) Fred P. Opp, Cleveland, O., asks us how much it costs to have an attorney make a search in the Patent Office in order to find out whether an invention is patentable.

(A.) There is no fixed charge for work of this kind to our knowledge. Some attorneys do not make any charge whatsoever if they have an order to patent an invention. Others charge small sums from a few dollars upwards, all depending upon how much work has to be expended.

At the Patent Office most inventions are filed in classes, thus, for instance, there is a class for wireless detectors, another class for non-refillable bottles, another class for electric lamps, etc. It is easy to understand that if a patent attorney must consult several thousand previous patents the charge will be very much higher than in the case of a new art; as, for instance, a wireless detector, of which not over 200 have been patented. For that reason it will be seen that it is impossible for anyone to say how much the fee will be, and the best thing in this case is always to consult a patent attorney and find out. Such information is gladly given by all attorneys.

Patenting a Hook-up.

(5) William B. Nelke, San Francisco, Cal., has sent in a blue print showing the hook-up or diagram for a wireless telephone and wishes to know if we think that he can obtain a patent on this invention.

(A.) Nothing new is seen in the hook-up which our correspondent has submitted

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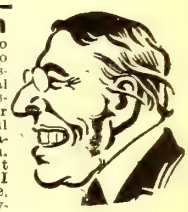
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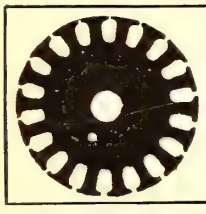
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to us. While the arrangement of the choke coils and the connection of the microphone differs somewhat from existing connections, we do not think it would be a wise thing to attempt patenting this hook-up, as we are quite positive that no patent could possibly be obtained.

We advise against attempting to patent any kind of a hook-up because it is one of the very hardest things to obtain a good patent on mere connections or circuits. Unless some novel instrument or other features are made a part of the patent a circuit alone will not be of much value, as most anyone could use such a circuit anyway, privately or otherwise, and it would be almost impossible for the patentee to know whether anyone was infringing on his patent or not. There are, of course, a good many circuits or, as they are usually termed, systems patented, but we doubt if there are many of much commercial value.

BARON MÜNCHHAUSEN'S NEW SCIENTIFIC ADVENTURES.

(*Continued from page* 90.)

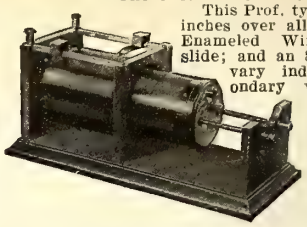
"tasted" exactly like sulphuric acid fumes, similar to the fumes given off by a storage battery when it is "gassing." After a few minutes we became accustomed to the sharp atmosphere, but we found it very hard to breathe at first. Then our bewildered senses became conscious of the fact that we felt a warm glow all over our bodies and in a few minutes we became exhilarated as if intoxicated. For three-quarters of an hour we were actually drunk, and it was exceedingly hard to think clearly during that time. This effect, however, wore off too, and at the end of the second hour we could breathe fairly easy, although our lungs pained terribly and we spat blood at frequent intervals.

An analysis of the moon's atmosphere made by us shortly thereafter explained our odd behavior and the strange effects of the new air upon us. To begin with, the moon's air is very thin, only about 1-16th the density of the earth's atmosphere. Where the earth's atmosphere is composed of about 79 per cent. nitrogen and 21 per cent. oxygen, the moon's atmosphere contains 26 per cent. carbon dioxide, 24 per cent. nitrogen and 50 per cent. oxygen. The carbon dioxide caused us to cough so violently while the invigorating oxygen in its prepondering proportion in the air intoxicated us. If the moon's air were as dense as that on the earth I doubt if a human being raised and brought up on earth could survive. But by being 1-16th as dense as the terrestrial atmosphere, together with the fact that oxygen is very beneficial to the respiration, it becomes possible to endure the moon's thin air comfortably. It is interesting to note that if vitally necessary human nature will adapt itself successfully to even the most difficult surroundings. This we found out speedily; within 48 hours we not only breathed with comfort and wholly without pain, but we found the new air so enjoyable as well as invigorating that we looked forward with dread of again inhaling the stuffy terrestrial atmosphere. After one grows accustomed to the singular smell of the moon's air one comes to cherish it. It acts like a powerful tonic, the oxygen no doubt being largely responsible for this.

At first, of course, we found it very difficult to walk on the moon's surface, for the reason that we weighed so little now. The earth being 50 times as large in bulk and 1.66 times denser than the moon, it naturally attracts all bodies with much greater force than does the moon.

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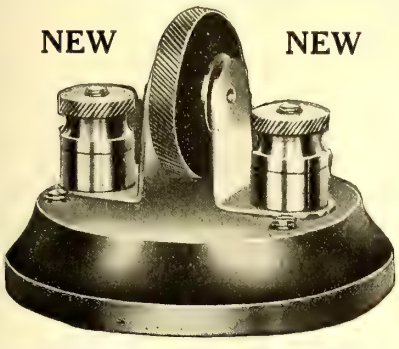
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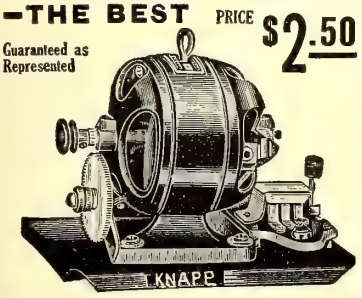
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Thus a stone weighing one pound on earth weighs but 0.167 lb. on the moon, which is just one-sixth of the weight the stone has on earth. My own weight on earth being 170 lbs. it naturally follows that I could weigh but 28 lbs. on the moon. Buster, who weighs some 10 lbs. on earth, weighs but 1½ lbs. on the moon. He found this out soon when he began to jump about. On earth he would not have jumped higher than about 4 feet. On the moon his 1½ lbs. carried him six times higher, for he expended as much muscular energy in his jump as he was accustomed to do on earth. Consequently he went up some 24 feet into the air. This frightened him considerably, for he had never jumped so high in all his life. As in the *"Interstellar,"* he became more careful thereafter and limited his jumps to 10 or 15 feet in height.

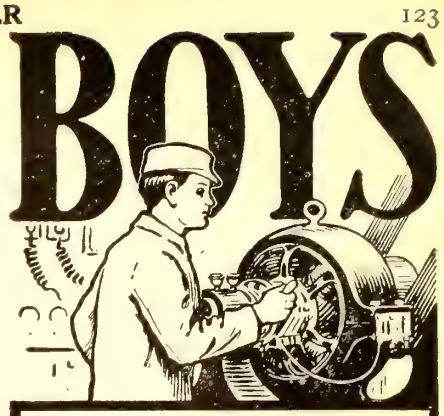
Flitternix, as well as myself, amused ourselves in a jumping contest for some time and it was astonishing to us how high we could jump. Twenty-five to 30 feet was easy of accomplishment, and we did not come down hard either, for we weighed so little. One thing, however, we found out speedily. The moon's atmosphere even at the little elevation of 30 feet becomes so thin that it is impossible to breathe. For that reason we discontinued our high jumps soon and preferred long horizontal jumps after that. Subsequently we established the following facts:

The only atmosphere in which any kind of living creatures could exist extended but 20 feet above the surface of the moon. Sixty feet above the moon there was no trace of atmosphere. Here the vacuum of space begins. On earth, it will be noted, no atmosphere exists beyond 35 miles above sea level. Thus we found it impossible to scale the lunar mountains or even a low hill.

There being so little atmosphere on the moon, no clouds whatsoever, and but very little wind, it follows that the temperature of the moon's surface must be rather comfortable. We measured 78° Fahrenheit in the shade of the *"Interstellar."* Nor did this summer heat subdue during the long day of nearly two weeks. (The length of the day on the moon is almost two weeks, the length of the night being of the same duration.) This intense sunlight also made it impossible to walk about without some form of protection, but as we had brought our tropical sunshades along we were but little troubled on our long tramps, despite the heat. Without this precaution our hands and face blistered rapidly, due no doubt to the effect of the sun's ultra-violet rays through such a thin atmosphere, which offered but little protection.

After several hours immediately following our landing we concluded to leave the desert in order to investigate the nearest chain of mountains some 60 miles distant. Re-entering the *"Interstellar"* we started our tractor machinery and the big globe began to roll on its wide landing belt over the hot sands of the moon at a comfortable speed. In a few hours we came to a dead stop in the shade of an enormous mountain rising some 16,000 feet above the surface of the moon. No vegetation or any sort of life could be perceived anywhere, but curious marks on the ground convinced us that there must be indeed some form of life on the earth's satellite.

Arming ourselves with our large caliber guns we set out to follow the tracks. Buster, who ran ahead of us with his nose to the ground, had become excited and within a ten minutes' walk we entered an immense canyon with almost perpendicular walls several thousand feet high. This canyon was nearly closed at the top and



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it was probable that the sun never reached the bottom. There was but little light and we had to advance cautiously, guided by Buster.

The temperature was rather comfortable, about 50° Fahrenheit, as our subsequent investigation proved.

As we walked on, the canyon seemed to become lighter, but we soon observed that it was not sunlight. The color of the light was of a pale green. We were very much puzzled at this and not a little excited, so we pressed on forward. We finally rounded a projecting corner and beheld a sight such as no humans had ever seen before.

The canyon, which by this time had become entirely closed at the top, suddenly widened out into a colossal cave of immense proportions. We found out later that the cave was roughly 12 miles in length and 8 miles in breadth. Although entirely closed at the top it was almost as light as day inside, the light, however, being of a vivid green. Almost the entire bottom of the cave was taken up with a lake and the light came from the lake itself. Within a few minutes we had reached the edge of the water and we saw immediately why the lake gave forth such a strong light.

We stood fascinated for some time at the sight which presented itself to our eyes. The lake was crowded as far as the eye could reach with a sort of eel fish —*and each fish was luminous.*

You have, of course, seen the common firefly during a hot summer evening. Take your firefly, extend it about four feet to the size of an eel, put it under a clear limpid water, and you have a good description of our lunar luminous fishes.

The sight of these strongly illuminated eels darting back and forward under the water with lightning speed is magnificent; it offers a wonderful spectacle. You can follow each fish to a considerable depth, for the light which they emit is very powerful. We found out that each fish produces some 60 candlepower of light. Here at last we are face to face with an exceedingly practical application of "cold" light, which our terrestrial scientists have been searching for for decades. We also observed that the fishes are luminous only while in motion. As soon as they stop swimming the light vanishes instantly. We have since observed that the light is produced by the friction of the fish's body against the water. Flitternix is not sure as yet whether the action is electric or chemical.

We marveled how nature always finds out a way to favor life, even under the most difficult surroundings. As life was manifestly not possible on the moon's surface on account of the blistering heat (and the extreme cold following) nature promptly produced it *under* the surface. As the higher forms of life require light for their existence and as there was no light under the moon's surface, nature saw to it that its life carriers were equipped with light themselves!

We were naturally overjoyed at our discovery. We knew now that there was at least water on the moon, despite all our scientists' theories. Buster was the first to try it and after a few cautious licks he decided that it was really water. We followed suit and immediately noticed that the water was slightly tart in taste, which, however, made it an excellent thirst quencher.

We discovered later that all of the moon's subterranean waters tasted alike, the tartness undoubtedly being produced by the ever-occurring sulphur which seems to abound on the moon.

We found it was comparatively easy to catch one of the luminous fishes, which was almost 4 feet long, and after killing it we decided to take it along to test its edibility. During the next few hours we also killed several luminous turtles of enormous size. As we did not see any other living creatures on the shores of the lake we decided that it must have been one of these turtles whose footprints we had seen outside of the canyon.

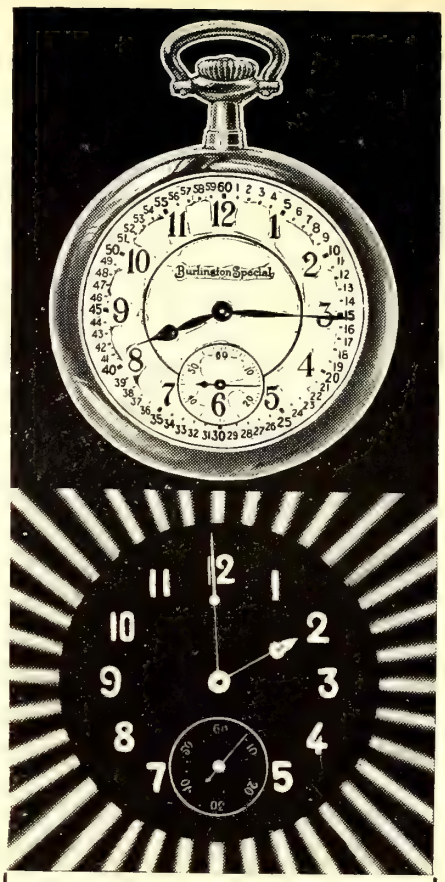
A survey of the cave showed that its southern wall was composed almost entirely of some form of coal similar to our terrestrial anthracite. We knew now that we were in no danger of starving. We had the water from the lake, meat from the fishes, as well as the turtle, and fire from the coal. We naturally felt highly elated, so Flitternix as well as myself decided to extend our visit to the moon as long as practical in order to fully investigate this newest world.

During the next few days (by this I mean a day of 24 hours' duration) we explored the entire cave and we came across many queer animals, mostly of the turtle type. We found few hairy or feathered types and nothing that approached even distantly the human form, as, for instance, the monkey type of our earth. We found that there was quite a little vegetation inside of the cave, mostly of the fungus type; there were also low shrubs and some dwarf forms of a peculiar bread tree. This bread tree is very similar in many respects to the terrestrial bread tree (*Artocarpus incisa*) as grown in some of the Pacific Ocean islands. We found its fruit, after baking it, highly nutritious as well as exceedingly tasty. The turtle meat was excellent and the fishes tasted somewhat like eels, with a fresh-water trout flavor. We found many varieties of mushrooms, some of enormous size and mostly edible. There was, furthermore, an abundance of various curious nut bushes and, with a few exceptions, all were very tasty.

You see we do not starve on the moon, even if it does look dead through a telescope. On the contrary, we are well provided for and could extend our stay indefinitely if we were so inclined. As a matter of fact we are in no hurry just now to return to mother earth, we like it so exceedingly well here.

We discovered soon that there were thousands of caves such as the one which we first discovered scattered all over the moon. These caves are all much the same, all illuminated, by means of their luminous animals. The caves vary, of course, much in size as well as in shape; some of them are hundreds and some even tens of thousands of feet below the surface of the moon. This is quite natural. The moon is a cold world unlike the earth, which is still in a molten state in its interior. The further you descend in the moon's bowels the colder it gets, but the atmosphere becomes denser also. Equipped with electric lanterns, we visited a cave several hundred feet below the moon's surface. The cold was intense, and we saw no living being of any sort, nor any plant life. What had been water once, myriads of years ago, was ice now, frozen down to the bottom. The sight was so desolate and so depressing that we hurried back to the surface as soon as our investigation was completed. We decided not to visit any more caves except those located near the surface of the moon, where the solar heat still could make itself felt.

During the next few days we found immense deposits of various metals, such as platinum, gold, copper as well as iron ore. There seems to be an abundance of these metals on the moon. We also found a curious metal (or it may be an alloy) which melts at a temperature as low as that of tin, but is as hard and flexible as steel.

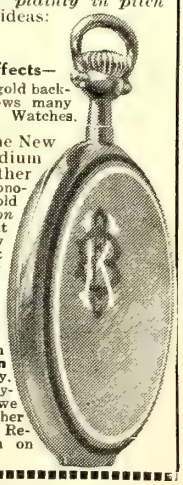


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But now, my dear Alier, I must terminate our chat for this evening. This is moving day for us. The sun is chasing us rapidly and Flitternix says we have only three hours before the *shadow* overtakes us."

"I do not quite follow you, my dear Münchausen; won't you be a little more explicit, please?"

"Certainly, my boy. You know that the moon revolves on her axis once in about 27 days. Her term of daylight must therefore be the half of 27 days, or nearly two weeks, and her night must consequently be of the same length.

"At the present we are somewhat in the neighborhood of the moon's equator. Within a few hours the spot on which I sit will be in the dark—it will be night—the beginning of the lunar two weeks' night. Already the sun is low in the heavens. As the temperature will fall below zero as soon as night sets in, and as we do not cherish to be frozen we have no other choice but to move our present position. We will, therefore, break up our camp shortly and will board the "*Interstellar*" once more. A few hours' ride will bring us to the other side of the moon, where it is now morning. Once we reach that spot we can make camp again for two weeks, the duration of the lunar day.

"Well, I must hurry, my dear boy; anyhow, it is one o'clock for you now and I have an idea that your bed is calling you. Therefore, *au revoir* till next time."

Keee-ee-ee-ee, Zeee-ee-ee-ee-ee. Zeee-eee-ee-eee é é é é é eeh-blob-blobb-flum-, and he was gone. The ether was quiet once more.

ELECTRICITY, THE POWER BEHIND THE SUBMARINE BOAT.

(*Continued from page* 105.)

base on board a German warship or a land station.

The general lay-out of the electrical equipment on board the submarines, and particularly the storage battery unit, is such that when cruising, or when lying to, the oil engine can be used to drive the dynamo by suitable throw-over mechanical gear and the dynamo then charges the storage battery so the vessel will be ready for the next dive under water.

The storage battery supplies electric current for a large number of different apparatus on board, including several electric motors for driving water tank and submersion pumps; also the current for operating electric heaters placed about the walls of the submarine, electric lights, the radio transmitting set, compressed air pump, small ¼-h.p. motor for turning the sighting periscope, through which the commanding officer obtains his view of warships, etc., on the surface of the sea, as the illustration shows, et cetera.

Also other uses of the electric current include that for heating the stoves or ranges for cooking the meals of the crew, electrical triggers or release mechanisms for discharging the torpedoes through the torpedo tubes, and which are propelled out of the tube by compressed air from an air storage tank in most cases. Also a small but powerful electric searchlight is provided on the upper deck of the submarine, which can be used when she is cruising on the surface, and duplicate installations are made; on the upper deck as well as on the inside central control deck where the commanding officer stands



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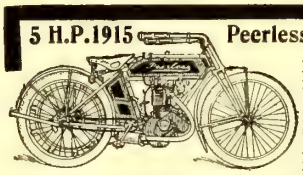
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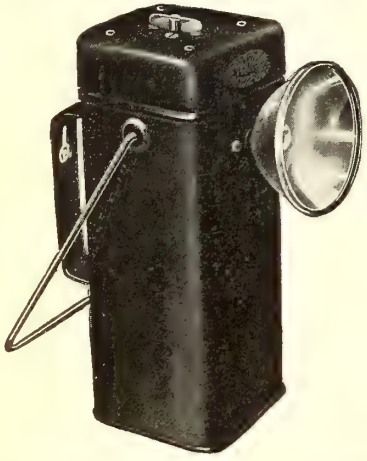
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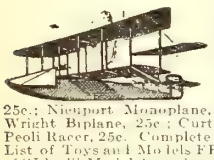
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The modern submarine is, furthermore, equipped now with a complete telephone installation as well as speaking tubes from the officers' central control deck, so that orders may be transmitted from the commander's position before the periscope to any part of the boat instantaneously. It is now common practise to fit the submarine with an auxiliary electric lighting system equipped with 6-volt portable lamps and storage battery as well as dry battery, in order to operate same for several hours in cases of emergency.

In time of war it is thus seen that the submarine commander has a very highly perfected and centralized means of control which is at his fingers' ends, so to speak. When he has sighted a warship of the enemy which is to be torpedoed, which sighting is done by coming to the surface for a few minutes so that the periscope projects above the water a foot or so, he then gets the range and swings the submarine so that one of her torpedo tubes is pointed in the proper direction at the enemy ship. He can then press an electric button which controls the compressed air discharger of the proper torpedo tube, and he will then, and generally does, submerge instantly.

All of this may sound complicated, but as a matter of fact it only requires a few seconds, or at most a few minutes, to bring the submarine torpedo tubes into the proper angle to hit the enemy's ship, momentarily rising to the surface so that the periscope will give a view of the target for range-finding so as to accurately discharge the torpedo.

In most cases, before the gun pointers of the warships can discharge any shells at the submarine it has sunk from view, and the next minute they may be hit by the terible torpedo, which has the power, in most cases, to quickly sink the most powerful and heavily armored dreadnought afloat. The torpedoes fired have a range of two to three miles and even more in some types. It should be noted that our illustration does not show every detail, such as chairs, tables, bunks, etc., as these are outside the scope of this treatise.

MARCONI INJUNCTION HOLDS.

Judges Lacombe, Ward and Rogers, sitting in the Circuit Court of Appeals, handed down a decision recently affirming the order of Judge Hough granting a preliminary injunction to restrain the de Forest Radio Telephone & Telegraph Co., the Standard Oil Co. of New York and Lee de Forest from infringing the fundamental Marconi and Lodge patents relating to wireless telegraphy.

It had been urged by the defendants that it was unfair that they should be restrained from the use of the de Forest system pending the determination of the patent action brought by the Marconi Wireless Telegraph Co., on the ground that the Marconi people had recently raised the price it charged steamship companies for the use of its system to $100 a month for each vessel.

BUILD YOUR OWN

GRANDFATHER'S CLOCK

WITH OUR HELP



We furnish blue prints, finishing material and instructions. Buy the works, dial, weights and pendulum from us at surprisingly low prices. You make a fine profit building artistic clocks for your friends Complete works, $5.00. Others with chimes at all prices. Ask for attractive free offer.

Clock Company

1661 Ruffner St.

PHILADELPHIA, PA.



HOWARD BICYCLE

Something new in a bicycle; you cannot afford to buy until you get our 1915 catalog. Make some extra money, be a rider agent. **Send for our Free Trial Proposition.** Write to-day.

HOWARD CYCLE CO.

Dept. EE. Trenton, N. J.



September Morn

WATCH FOB. Exactly like illustration. The latest fob out. Has bewitching little figure of Miss "September Morn" handsomely embossed on heavy metal plate. Beautiful oxidized silver finish. Size of medal 1¼ x 1¾. Genuine black leather strap. Boys, a real work of art. Classy, alluring. **Makes 'em all take notice.** Agents wanted everywhere. Dandy sample fob and our great easy money proposition to hustlers sent

Postpaid 25 cents.

NOVEL JEWELRY CO.

707 Lewis Block Buffalo, N. Y.

WIRELESS BLUE BOOK

Who's Calling?—You always know if you have a Wireless Blue Book on hand. Has alphabetically arranged list of all call letters of U. S. and American Wireless Telegraph Stations, Merchant Vessels, Vessels of the U. S. Navy, Revenue Cutters and Licensed and Unlicensed Amateur Stations and their location corrected to August 1, 1914. The most complete book of its kind ever published and one you cannot afford to be without. Size 6x8 inches, paper bound, with map of United States showing all principal radio stations, both government and commercial. Sent prepaid on receipt of 15c. Send now so that you can tell who is calling and being called.

"BOOK DEPT."

Experimenter Publishing Co., Inc.

233 Fulton St., N. Y. City

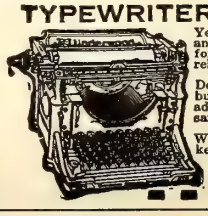
LEARN TELEGRAPHY

Morse and Wireless—R.R. Accounting (Station Agency) taught. Splendid opportunities. Positions secured. Marconi Co. takes our wireless graduates. We own and exclusively occupy two large modern buildings equipped with R.R. and Western Union wires and complete $3,000 Marconi Wireless Station. Largest School—established 40 years. Investment $25,000. Endorsed by Railroad, Marconi and Western Union Officials. Expert practical teachers. Low living expenses; easily earned if desired. Tuition low. Easy payments. Correspondence courses also. Catalogs free.

Dodge's Telegraph Ry. & Wireless Institute

E 8th Street Valparaiso, Ind.

TYPEWRITER PRICES SMASHED



Yes sir. I have smashed typewriter prices right and left, and I guarantee to sell you a machine for less money than anyone else. I am the largest rebuilt typewriter buyer in the United States.

500 MACHINES AT $10 TO $15

Do not pay 20 to 40 per cent more when you can buy from me. Rebuilt typewriter prices have advanced tremendously, but I still stick to the same prices.

All Machines Guaranteed For 3 Years

When you buy from me, you get a guarantee to keep the machine in repair for 3 years. Write for **FREE** descriptive circular.

"Spot Cash" Gaertz, Pres.

Dearborn Typewriter Exch., Dept. 628 Chicago

Opportunity Exchange

YOU will probably find more opportunities and real bargains in these columns than anywhere else in the country. Most good things in life are hard to find and worth going after—these little ads illustrate that point; you alone will be the real loser if you don't take the time to scan through these columns.

Advertisements in this section 4c. a word for each insertion. Count 7 words per line.

Name and address must be included at the above rate. Cash should accompany all classified advertisements unless placed by an accredited advertising agency.

Ten per cent. discount for 6 issues, 20 per cent. discount for 12 issues from above rate. Objectionable or misleading advertisements not accepted.

Advertisements for the August issue should reach us not later than July 10th.

EXPERIMENTER PUBLISHING CO., INC., 233 Fulton Street, New York, N. Y.

BOOKS

"TRAFFIC in Souls." This book is based upon the most widely discussed motion picture production. It is a powerful study of vice conditions in New York, and the facts upon which it is based were compiled from the Rockefeller White Slave Report. Illustrated with striking photographs. 300 pages. Send prepaid for 60c. Hesse Mercantile Co., 12 East 22d St., New York.

360 POPULAR TOASTS. Selections suitable for all occasions; just what you need at an evening supper; 10c. "Km.," Wedge Manufacturing Co., Binghamton, N. Y.

"HUNDRED Ways to Kiss a Girl" and other things. Something real good. Price 25c. Bronx Girls Club, 417 E. 151st St., New York.

PIGEONS—The finest Pigeon Magazine, $1.00 a year, or send 25c. for four months' trial. Pigeons Magazine, 948 Advertising Bldg., Chicago.

MODERN Dances—Best Instruction Book for beginners. 17 dances fully illustrated. 25c. prepaid. Danse Publishing Co., 500 Fifth Ave., New York.

HAVE YOU SEEN A COPY?—Amateur Photographer's Weekly, $1 per year; weekly prize competitions; criticisms; print exchange; illustrated; many features. Three months' subscription 25c. Amateur Photographer's Weekly, 915 Schofield Bldg., Cleveland, Ohio.

ENGINEERS' questions and answers for license by Hobson for 25c. postpaid. Send stamps. Reilly's Book Store, Dept. E., Philadelphia, Pa.

BICYCLES AND MOTORCYCLES

CLOSING Out Sale high-grade slightly used motorcycles. We have about 50 left to sell, in standard makes which we are offering at big bargains, such as twin and single-cylinder Indians, Yales, Harley-Davidsons, Merkels, Thors, Excelsiors, Popes, 4-cylinder Hendersons and Pierces. These motorcycles we want to close out this year. No reasonable offer will be refused. Write to-day for our list giving description and prices. Gotham Sporting Goods Co., 57 Warren St., New York City.

FOR Sale cheap. 1914 Harley-Davidson twin. Write for particulars. Walter Goerke, 321 Washington St., Newark, N. J.

1908 H. D. SINGLE with clutch and magneto, $30. 1910 H. D. battery model. A-1 condition, $35. 1911 H. D. single magneto model and clutch, $40. 1910 H. D. clutch and magneto, $45. 1 Indian motorcycle motor with magneto and Schebler carburetor, $25. 1 Excelsior motorcycle motor, $25. C. H. Lang, 1704 Michigan Ave., Chicago, Ill.

$50 TO $150 buys the best Motorcycles, every make and model in our large stock—must be cleared. Half price. Send for list to-day. Talking Machines, $5 and up. Brown Music Co., 9119 Commercial Ave., Chicago, Ill.

SEND for latest Bulletin of real Motorcycle Bargains, used and slightly used, all makes, models and prices; if you have $25 and really want a powerful Motorcycle, send for this Bulletin; hundreds of machines at all prices, new ones on easy payments; tell us what you want and how much you can pay; we can fix you up. Peerless Motorcycle Co., Dorchester, Mass.

USED Motorcycles, all makes, bargains. Send for list. Ward Bros., 212 Broadway, Camden, N. J.

OUR folder showing the new '15 Eagle 2-speed models is ready for mailing. Write for this and for the agency to-day. Sterling Motor Co., Brockton, Mass.

RIDERS: Write for our catalogue of motorcycle accessories and supplies. Andrews Specialty Co., 55 Warner St., Rochester, N. Y.

* * * * * * * * * * *

Brooklyn, N. Y., April 15, 1915.

Gentlemen:—The results obtained from my advertisement in the "Electrical Experimenter" really surprised me; in fact the demand for a certain instrument of mine exceeds the capacity for manufacturing and it is all through the "E. E." To date, 79 inquiries, 12 orders. Might state last week filled a $50.00 order netting me a profit of $18.75. As to the exact value of my orders to date, I prefer not to give figures; however, you will always see my ad, month in and month out. I can truthfully say that the "E. E." has it on them all, viz., for quick results, interesting reading matter, etc. Very truly yours. HARRY Y. HIGGS.

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FORMULAS

GOLD, SILVER, Invisible and Luminous Inks. Formula, 10c.; 4 for 30c. J. Bryon Long, Salem, Ia.

1,000 TRADE secrets and formulas, 25c. 500 selected formulas, 20c. Resilver mirrors, guaranteed process, 20c. Make Sneezing Powder and Itch Powder, 10c. each. Entire lot, 50c. Service Bureau, 3111-T, Belleplaine Ave., Chicago.

MAKE Candy evenings; pays; receipt, 10c. Elmer Zimmerman, 1435 Walnut, Harrisburg, Pa.

ANY FORMULA WANTED—Sent for 20c. 3 Invisible Ink formulas, 25c. State requirements to Kelson Laboratory, Box 433, Elmwood, Ill.

SIX Valuable formulas for sympathetic inks, 50c. Wayne Thomas, Ithaca, N. Y.

FORMULAS for inks, black, blue, red, gold, green, silver, indelible, 15c each. 7 for $1.00. Stephen Rafferty, 2122 Arch St., Philadelphia, Pa.

CUTS anybody can make, 5c. Samples Stamp. Modern Engraving Co., Lynn, Mass.

AGENTS—Build a business of your own with our Piano and Furniture Polish. Have used it in our shop successfully for five years. Send $1.00 for formula and trade secret. E. E. Lundberg School Piano Tuning, 143 N. Dearborn St., Chicago.

PHOTOGRAPHIC

FILMS developed, all sizes, 10c. Prints, any size, 4c. each, 35c. per dozen; double weight paper used; needs no mounting; post cards same. E. H. Flowers, North Platte, Neb.

SPOT Cash paid for high-grade Kodaks, Lenses and Cameras. Send full description, stating lowest price. Cameras exchanged. In business since 1885. David Stern Co., Dept. M, 1047 W. Madison St., Chicago.

FILMS developed, 10c., all sizes. Prints 2¼x3¼, 3c.; 2½x4¼, 3½x3½, 3¼x4¼, 4c.; Post Cards, 50c doz. Work guaranteed and returned 24 hours after receiving. Postpaid. Send negatives for samples. Girard's Commercial Photo Shop, Holyoke, Mass.

EXPERT Kodak Finishing! Send for price list. Electric Studio, 162 Stephenson St., Freeport, Ill.

KODAK films developed. 5c., all sizes. Prints, 3c. each, any size. P. Johnson, 100 W. Bridge St., Oswego, N. Y.

TRANSFER pictures to china, etc.; no formulas; particulars. Flinn, 286 West 142nd St., New York City.

THINK OF IT! Only $20 for finest German Double Anastigmat in Ibso shutter, for 3A Kodaks and postal card cameras. Send for matter describing best Lenses on earth at way down prices. Lafbury Co., 305 North Fifth Ave., Chicago.

FILMS developed 10c., all sizes, prints 2¼x3¼, 3c.; 2½x4¼, 3½x3½, 3¼x4¼, 4c.; Post Cards, 50c. dozen. Work guaranteed and returned 24 hours after receiving. Postpaid. Send negatives for samples. Girard's Commercial Photo Shop. Holyoke, Mass.

$54 CENTURY Grand, bargain, $25. Magnificent Ensign Reflex, Zeiss Triotar Anastigmat, complete, $65. $22.50 Autographic Kodaks, $19.75. Slipin Calender Mounts, assortment, $1. Catalogues mailed. Newark Photo Supply Co., Newark, New Jersey.

HEADQUARTERS for selling or exchanging Cameras of all kinds. Carry a full line latest Kodaks. Graflex. Premos, foreign Cameras. Write for big bargain list. Gloeckner & Newby Co., 171 Broadway, New York.

KODAK Films Developed, 10c. per roll, any size. Prompt attention given mail orders. Prints, 2¼x3¼ to 3¼x4¼, 3c.; 4x5 to 3¼x5½, 4c. J. M. Manning, Box B, 1062 Third Ave., New York City.

MAGIC AND TRICKS

MAGIC pocket trick free. Worth 25c. With illustrated catalog of 250 tricks, puzzles, illusions, for 6c. Stamps. Magic Co., Sta. 10, 249 West 38th St., New York.

POST Cards, Tricks and Jokes, Coins, Notes, Stamps and curious things. Catalog for stamp. Coin Exchange, New Rochelle, N. Y.

BIG Catalogue. Magic, Entertainment goods free. Bates Co., Melrose, Mass.

MAGIC Tricks, Jokes and Puzzles. Trick with my catalogue, 10c. coin. H. V. Dils, Huntington, W. Va.

GREAT book wonders, secrets and mysteries and novelty catalogues, 10c. Wright Spec. Co. (D), Brewster, N. Y.

MAGIC tricks for the profession. Big catalogue and pocket trick free. Ventriloquial figures, $6.00 up. Magic Parlors, 192 Clifford, Providence, R. I.

NOVELTIES, Books, Tricks, Games, Etc. Illustrated catalogue free. Sample 25c. card trick, 10c. Auburn Supply Co., Specialty Dept., 7745 Peoria St., Chicago.

SECRO-WRITO; New System of secret writing. Keeps your correspondence safe and private. Strangers cannot read your cards and letters. Great fun for everybody. Samples and instructions, 10c. H. J. Teeple, Decatur, Indiana.

GREENBACKS—Yellowbacks, Stage money. New kind, 10c. bunch; 4—25c. Eureka Supply, P29, 3827 N. Kenneth, Chicago.

250 MAGIC Tricks with cards, coins, etc., 10c. Greenbacks, big wad, 10c. Novelty Shop, 3311-T, Belleplaine Ave., Chicago.

MISCELLANEOUS

ENGINE Lathe, swings 9½ in., takes 25 in. between centers. Complete set gears cutting all size threads 3 in. to 40 in., $43.50. Grammes & Sons, Allentown, Pa.

MANSFIELD'S Electrical Water Finder is a thoroughly reliable appliance for locating positions for sinking wells for pure water supplies. Send for particulars to Mansfield & Co., Engineers, New Brighton, England.

ELECTRIC Light Plants, consisting of ⅓ H.P. gasoline engine, 60-watt dynamo, switchboard with volt and ammeter, lamps, wire, switches, etc., complete, $32.50. Descriptive Bulletin for stamp. Dynamic Manufacturing Co., 1730 First National Bank Bldg., Chicago.

DRAWINGS made for inventors. Consulting Engineer, EE-3240 Seminary Ave., Chicago.

MODELS

MODELS made for inventors; general machine work; designing and perfecting; developing automatic devices and machinery; in a position to do all kinds of light tool and machine work. Prices reasonable; estimates cheerfully given. Ideal Machine Works, 62 Ann Street, New York City.

INVENTORS: We manufacture metal articles of all kinds to order. Also special machinery, tools and dies; punchings, lathe and screw machine work, metal spinnings, castings, plating, wood and metal patterns, etc. Send sample for estimate and expert advice, free. The Eagle Mfg. Co., Dept. E, Cincinnati, Ohio.

SMALL Gasoline and Steam Engines and Castings. Experimental apparatus. Toys. Big catalogue for 10c. Amateur Mechanics Co., First National Bank Building Chicago.

PRODUCERS of Results; Inventions Developed, Light Mfg., Models, Experimental Work, Tools, Dies and Stampings. Johns Machine & Stamping Works, Middle Bldg., Dept. C, Cleveland, Ohio.

MODELS, dies and manufacturing for inventors, by builders of "Tools That Work." La Croix Tool Co., 214 N. 21st St., St. Louis, Mo.

PATENT ATTORNEYS

PATENTS without advance attorney's fees. Not due until patent allowed. Send sketch for free report. Books free. Frank Fuller, Washington, D. C.

PATENTS SECURED OR FEE RETURNED. Send sketch or model for free search and report. Latest complete patent book free. George P. Kimmel, 254 Barrister Bldg., Washington, D. C.

STAMPS AND COINS

STAMP Album with 538 Genuine Stamps, incl. Rhodesia, Congo (tiger), China (dragon), Tasmania (landscape), Jamaica (waterfalls), etc., 10c. 100 diff. Jap., N. Zld. etc., 5c. Big list; coupons, etc. Free. We buy stamps. Hussman Stamp Co., St. Louis, Mo.

GET the most out of your money you can. Try my 1, 2 and 3-cent approvals and you'll be pleased. References required. Wm. Haase, 971 E. 39th St., Los Angeles, Cal.

STAMPS, 100, ALL DIFFERENT, FREE—Postage 2c. Mention paper. Quaker Stamp Co., Toledo, Ohio.

FOREIGN Stamps Free, 52 different foreign, including China and Venezuela, to all who apply for our high grade approval selections. Send two cent stamp for return postage. Edgewood Stamp Co., Dept. H, Milford, Conn.

$4.25 EACH paid for U. S. Flying Eagle Cents dated 1856. Hundreds of other U. S. and Foreign Coins wanted. Send 10c. at once for New Illustrated Coin Value Book 4x7. It may mean your good fortune. Clarke Coin Co., Box 94, Le Roy, N. Y.

MAIL ORDER OPPORTUNITIES

EVERYTHING in the mail order line; state your wants and we will do the rest. Pacific Specialties Co., Los Angeles, Cal.

EUROPEAN War Map and chances to start a profitable business of your own, 10c. C. S. Mathews, 69 East 87th St., Portland, Ore.

WE will start you in the cleaning and dyeing business. Little capital needed. Big profits. Write for booklet. Ben Vonde System, Dept. A-K, Charlotte, N. C.

WIRELESS

$10.00 COMMERCIAL KEYS for $4.00. Massie Wireless Telegraph Co., Providence, R. I.

EXCEPTIONAL Radio Apparatus. A 2c. stamp will bring my literature. H. Y. Higgs, 30 Irving Pl., Brooklyn, N. Y.

WE make Loose Coupler, 2,500 meter, $5; Tuning Coils, 350 meter, $2. Cliff Mfg. Co., Box 130, Brookfield, Mass.

AUDION Amplifier Hook-up. Marvelous! Uses one Audion only; Wireless Arcs, any size, Poulsen or Collins type; Inductance capacity, Wave length, Chart; Blueprints either one, 20c. H. Winfield Secor, Consulting Engineer, 2040 7th Ave., New York City.

AERIAL Masts: Build a "SU-PER-FECT" mast. Information 230 Stuyvesant Ave., Brooklyn, N. Y.

WIRELESS Operators: Send 10c. for any two name plates, "Phones," "Ground," "Aerial," "Battery." Carl Rhapstock, Plainfield, Wis.

3 CHARTS—Inductance of any coil, wave length of antennas, proper condenser for different spark-frequencies and voltages; sent, postpaid, for $1. A. S. Blatterman, B.Sc., 45 Lewis Pl., St. Louis, Mo.

BLITZEN Receiving Set, phones, other wireless instruments; perfect condition; half price. E. F. Rybolt, Dayton, O.

Scientific Exchange Columns

UNDOUBTEDLY you have at the present time some things for which you have no further use. Do you wish to sell these things or exchange them for something, for which you have immediate use? There is no surer and quicker way to do this than by advertising your articles in these columns. The **Very** people, the **Only** people, who could possibly have a use for your things read this journal. More than 30,000 interested people will see your ad. It is furthermore the cheapest advertising medium for you in the country.

The rates are: One cent per word (name and address to be counted) minimum space 3 lines. Count about 7 words to the line. **Remittance must accompany all orders.**

We reserve to ourselves the right to refuse any advertisement which we consider misleading or objectionable. Advertisements for the August issue should reach us not later than July 10th.

The Classified Columns of "The Electrical Experimenter" Bring Positive Results.

EXCHANGE—Bicycle and 2 frames, 1 Mandelete Camera outfit, 6 Pekin ducks, 8 aerial insulators, back numbers "Youth's Companion" for 4 years and story books. J. Royalton Smith, Osborne, Kan.

TWO wireless keys, 4 ohm W. U. sounder; cost $14. Exchange for Kodak. William Hyer, 314 S. 10th St., Philadelphia, Pa.

FOR EXCHANGE OR SALE—Loose coupler, variable condenser, fixed condenser, pair 2,000 ohm phones, detector, ½-in. spark coil, aerial wire, insulators, etc.; also battery motor, auto coil with magneto and battery switch. Will sell cheap or exchange for good motorcycle motor. Morris Ivy, 613 S. Anna St., Stuttgart, Ark.

FOR SALE—New and used wireless goods, such as 100-a, 600 V. slate base switches, $2.75, and Type A-A Crystaloi and test buzzer, $5.90. Send 2c. stamp for big list. All letters answered. A. Leroy Jennison, 83 Russell St., Waltham, Mass.

SALE OR EXCHANGE—Model self-inking hand printing press, No. 2, chase 7x9 in. Bought power press, have no further use for this. A money-maker. Dependable wireless apparatus for sale. Lloyd Gross, Pitman, N. J.

FOR SALE—3 headsets, 3 coils, 2 receiving, 2 battery motors, coupler, telephone, 2 telegraphs. E. R. Hough, Johnstown, N. Y.

WILL EXCHANGE pair 1,500 ohm receivers for Audion detector. Cash for broken Audion bulbs; have heavy lightning switch, magneto. Horton, 230 Stuyvesant Ave., Brooklyn, N. Y.

TWO Sliding Plate variables, $3; 2,000 ohm headset, $3; both, $5. Platt, Wentworth St., Bridgeport, Conn.

FOR SALE—Wireless instruments. For prices write Arthur Sacha, 3670 E. 40th St., Cleveland, O.

WILL TRADE—Motorcycle Gas Tank and two Speedometers for wireless goods. What have you? R. H. Leffler, Tiffin, O.

WILL SWAP—New Ingersoll Junior Watch; never used. What have you electrical? Loose Coupler preferred. Box 165, Waverly, Va.

FOR SALE—One Bb Clarinet, $7; one Bb Clarinet, $40; one Premo Camera with portrait attachment, nearly new, $8; one pair Opera Glasses, new, $4. Roy Jackson, Colome, S. D.

3100 Broadway, New York City,
5-29-'15.

Gentlemen:—

It may interest you to know that in answer to my advertisement in your Scientific Exchange columns, I have received to date fourteen answers, selling instruments to second inquirer. Either your paper is extra good or my price was too low.

HAROLD B. ADAMS.

FOR SALE—3,000 ohm Holtzer-Cabot receivers; brand new; have been used two weeks; $8. Write George D. Todd, Jr., New Albany, Ind.

FOR SALE—Loose Coupler, Silicon Detector, Fixed Condenser, Variable Condenser, 2,000 ohm phones and ½-in. spark coil, gap, 2 keys, condenser, nickeled headband, load coil, switch block. Harry H. Bonney, 103 S. Spruce St., Pana, Ill.

FOR SALE—One Professional Type Audion Detector, listing at $50; also cabinet type loose coupler, 2 condensers, Marconi phones and 2 crystal detectors. Will sell entire outfit for $50. L. Winat, 8-10 E. 107th St., New York City.

HAVE Blitzen Receiving Set; 2,000 ohm phones; many other wireless instruments; X-Ray outfit; 2-in. spark coil; write for list. What have you? R. F. Rybolt, Dayton, O.

FOR SALE—One ¼-in. Spark Coil; also other electrical novelties and supplies; will sell cheap. Write Kenneth Linnard, Peotone, Ill.

WILL sell 4-in. Electro Water Motor, coupling for plain faucet and 6-volt pony dynamo for $5.00. All brand new. E. Turner, 230 Hart St., Brooklyn, N. Y.

FOR SALE—Violin and Bow; new Stradivarius model; fine selected wood; genuine ebony trimmings; good tone. Price $6, prepaid. Luther M. Wiford, Sidney, O.

FOR SALE—Murdock 2,000 ohm, $5 head phones; perfect condition guaranted. First offer of $2.25 takes them. Raymond Schlegel, 1118 N. Negley Ave., Pittsburgh, Pa.

FOR SALE—A few steam and electrical books at half price. Henry Priebe, Kent, O.

VARIABLE Rotary Condenser, 31 plates and a pair of 2,000 ohm phones for a good camera or offers. H. Butterworth, 15 Kosciusko St., Brooklyn, N. Y.

EXCHANGE—Violin with canvas case, Harmonica, Flashlight, Books, Bicycle Lamp (gas); all in excellent condition. Will exchange for good Wireless Set. J. G. Schroeder, Wisner, Neb., Box 31.

FOR EXCHANGE—One E. I. Co. Tesla Transformer Coil, cost $5.50. Will exchange for Radioson Detector. Must be in good condition. Louis Menier, 526 E. 85th St., New York City.

TRANSATLANTIC Receiving Set, composed of the following instruments: Galena Detector, Radioson Detector, Loose Coupler, Variable Condenser, Loading Coil, Junior fixed Condenser, Variable fixed Condenser, pair of 3,000 ohm Government phones. Case to carry instruments. Set has never been installed. Cost $33.50; will sell for $15 or a good kodak; state style. J. Mitton, 377 Sickles St., Philadelphia, Pa.

¼ H.P. Gasoline Engine, suitable to run a generator, scroll saw, washing machine; bought four weeks ago; cost $23. As I need the money I will sell it for $16, or make an offer; good as new. J. Mitton, 377 Sickles St., Philadelphia, Pa.

2—¼-IN. Coils, good Punching Bag and Platform, 1 Vibrator, 1 Magneto. Want most any good radio instrument. Want offer. Ross J. Plaisted, Penn Yan, N. Y.

FOR SALE—Complete 1 K.W. Transmitting set, $20. Under ordinary conditions this set will send 50 miles. This set is similar to that of the Electro Importing Co.'s No. S.O.-200 outfit and is in excellent condition. Also have a 1½-in. Bulldog Coil, $3. Would like to exchange photos of radio station. Cecil Bridges, Louisville, Ill.

EXCHANGE—E.I. Variable Box Condenser, good as new. Will exchange for transparent 43 plate Variable Condenser. Louis L. Brandmeyer, Jr., Watertown, Conn.

FOR SALE—4 H.P. Steam Engine, horizontal style, $25; worth double; Rayfield Carburetor, fine condition, $9; new loud Auto Horn, $4. Bargains. Peter Nowak, 941 Merrill St., Milwaukee, Wis.

THE NEW
MURDOCK SPECIAL No. 55
WIRELESS RECEIVERS



With Regular Head Band

Complete 2000 Ohm Double Head Set

ONLY

$4.00



With Coronet Head Band $4.50

Absolutely high grade real wireless receivers, equal in sensitiveness, quality of materials, and dependability to any obtainable anywhere at many times the price.

We will, upon receipt of price, deliver a Murdock Special set, with the privilege of fourteen days trial. If for any reason the purchaser is dissatisfied, either with the receivers or our claims, the purchase price will be immediately refunded upon return of receivers.

SEND FOR CIRCULAR GIVING FULL DESCRIPTION OF THIS NEW HEAD SET

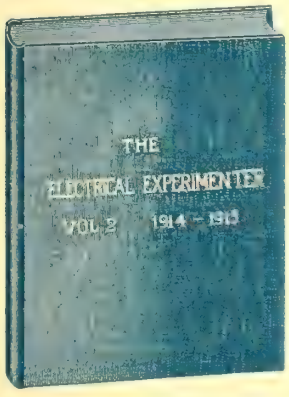
680 HOWARD ST., SAN FRANCISCO, CAL.

WM. J. MURDOCK CO., 55 Carter St., Chelsea, Mass.

STOP!

We hereby present one of the greatest bargains in electrical literature ever offered.

A complete Volume of the *Electrical Experimenter*, bound in rich, dark green linen, stamped with gold letters at the extraordinary low price of



75c.

Volume contains twelve numbers (from May, 1914, to April, 1915), **240** pages, **350** complete articles, **550** illustrations, **396** questions and answers.

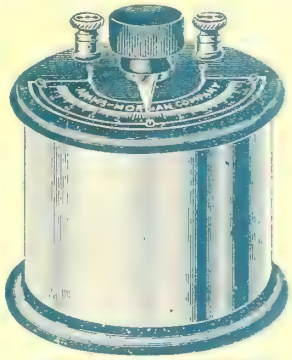
A world of electrical information; the entire electrical Progress for one year; the greatest reference book on current "Wireless"—all at a price as low as the *unbound* copies would bring. Mind you, the book is durably bound with heavy covers. You will be proud to have it in your library. We have only a few hundred copies, therefore be sure and order today. Shipping weight 2 lbs. Add a sufficient amount for postage.

EXPERIMENTER PUB. CO., Inc.

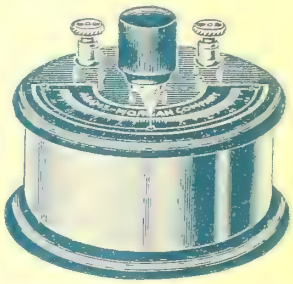
BOOK DEPARTMENT

233 Fulton Street, New York

OUR NEW BIG 216 PP. ELECTRICAL and WIRELESS CATALOG IS THE EXPERIMENTER'S REFERENCE BOOK



ROTARY VARIABLE CONDENSER
31 Plates Price $3.00



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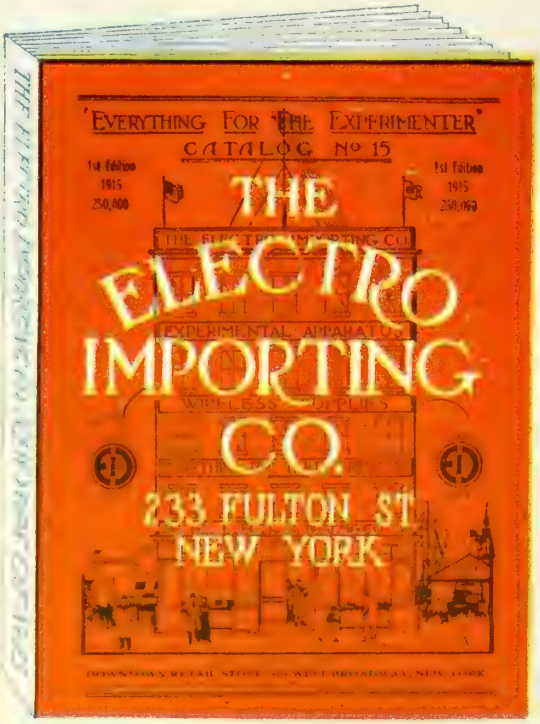
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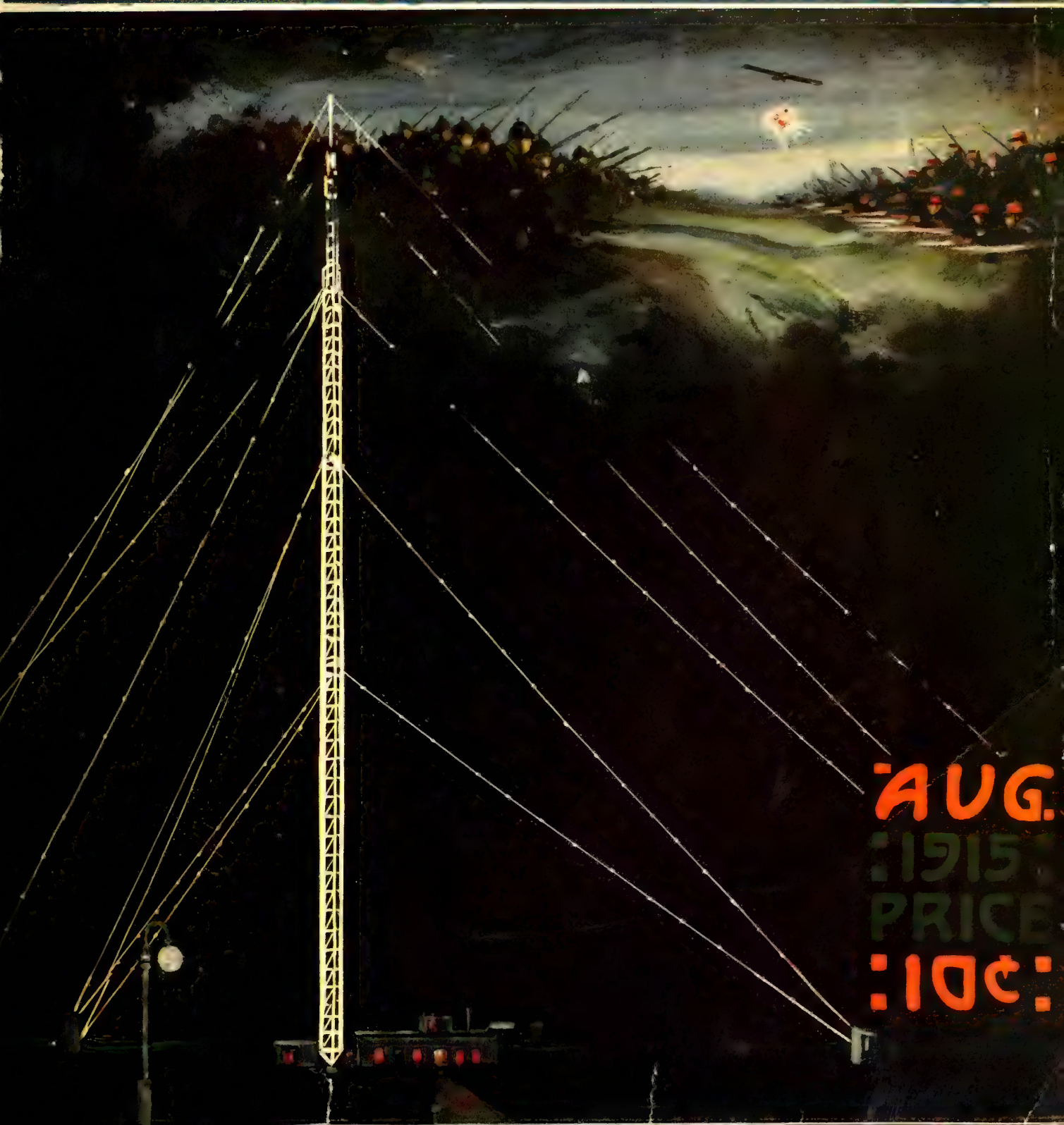
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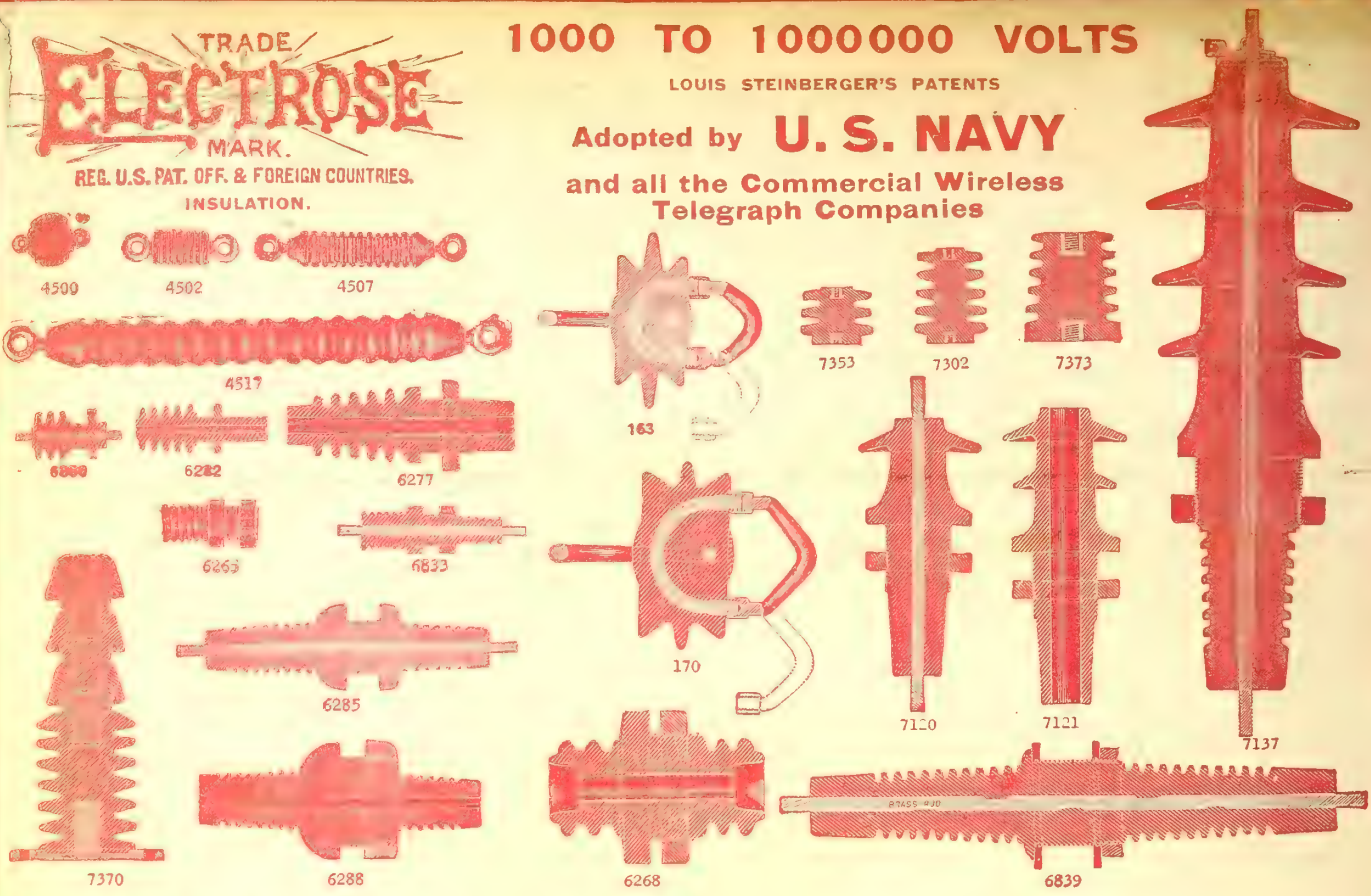
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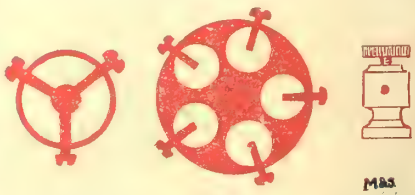
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Vol. III Whole No. 28 CONTENTS FOR AUGUST, 1915 No. 4

FRONT COVER—"SAYVILLE (N. Y.) WIRELESS RECEIVING GERMAN WAR REPORT." From a Painting by Thomas N. Wrenn ..... —
TELEVISION, OR THE PROJECTION OF PICTURES OVER A WIRE ..... By H. Winfield Secor 131, 132
SUBMARINE "WIRELESS" SIGNALING 133
ELECTRICAL CURE FOR "GUN-FIRE" DEAFNESS 134
HOW ELECTRICITY KILLS 134
NEW EDISON 3,000,000 C.P. STORAGE BATTERY SEARCHLIGHT 135
BARON MÜNCHHAUSEN'S NEW SCIENTIFIC ADVENTURES ..... By Hugo Gernsback 136, 137
HOW TELEPHONE MEN ARE TRAINED 138
HARMLESS RAY TO DO X-RAY'S WORK 139
FINDING UNEXPLODED BOMBS ON EUROPEAN BATTLEFIELDS BY ELECTRICITY 139
NEW ELECTRIC CLOCK SYSTEMS OF THE EQUITABLE BUILDING 140
ELECTRIC HOUSE WIRING TROUBLES ..... By W. F. Benington 140
ELECTRIC CHART TELLS PERCENTAGE OF DEATHS IN NEW YORK CITY 141
SOME FAMOUS ELECTRICAL LABORATORIES .. 142
HOW TELEPHONE TRANSMITTERS AND RECEIVERS ARE MADE 143
OUR SUPPLEMENT—"GUGLIELMO MARCONI" .. 145
AN INTERVIEW WITH GUGLIELMO MARCONI .. By Samuel Cohen 145
ELECTRIC SMOKE RECORDER 145
HIGH FREQUENCY MACHINE FOR TESTING INSULATORS 146
NEW 3-VOLT DRY CELL 146
A TRIP THROUGH THE COOPER-HEWITT ELECTRIC WORKS ..... By Theodore Hinchcliff 147
A NEW HYDROGEN X-RAY TUBE .. By F. C. Perkins 148
FEELING FOR ICEBERGS ELECTRICALLY 148
"THE CONSTRUCTOR" DEPARTMENT 149
"WIRELESS" DEPARTMENT 152
RADIO-AEROPLANE SCHEME FOR PROTECTING U. S. COAST LINE 154
WIRELESS RELAYS AND AMPLIFIERS 155
"HOW TO MAKE IT" DEPARTMENT 159
ELECTRICAL MAGAZINE REVIEW 162
"LATEST PATENTS" DIGEST 163
"AMONG THE AMATEURS" DEPARTMENT 164
"PHONEY" PATENTS 165
"QUESTION AND ANSWER" COLUMN 166

Sayville

SAYVILLE and Tuckerton are at present the only links connecting the American Continent directly with the German Empire. Both stations can now receive and transmit wireless messages to and from Germany, without any relaying means, at any given hour of the day.

First Tuckerton and now Sayville have been taken over by our watchful Government with the evident intention of preventing the two stations from committing an unneutral act, in conformity with international law practice.

The layman will immediately ask, that if the United States Government takes over the wireless plants, why does it not also take over the various transoceanic cable stations? He furthermore cannot see what harm the wireless stations can do, because they have been required for some time to use plain English or plain German, no code messages having been allowed since the outbreak of the war.

The answer is simple enough. A cable message during the time of its dispatch stays on the cable. It has only one destination; no one can "tap" the message without serious difficulties. Not so with the "wireless." Its waves being propagated in every direction, a thousand stations, or more, if properly equipped, can catch the message anywhere within the receiving radius of the sending station.

No doubt the far-seeing shrewd German Government long ago foresaw the possibility of a war with England and the inevitable isolation of the empire which would result in consequence thereof. It clearly foresaw the cutting of its cables by the enemy and it acted accordingly. Sayville and Tuckerton was the answer. Thus when England actually did cut the German cables early in August, 1914, Germany was by no means isolated telegraphically. Thanks to the wireless, which a wise government had long before planted on foreign soil, telegraphic traffic between America and Germany goes on the same as before, with the difference that the messages now travel over the very heads of Germany's enemies. With the inauguration of the German submarine warfare, the German Admiralty doubtless found a powerful weapon in the shape of the Sayville and Tuckerton wireless stations. The two stations being controlled almost entirely by German capital, it was reasonable to expect that they would support the German navy and its submarines to the best of their ability. Before the United States Government took over the Sayville station, early in July of this year, we had been reading a lot of nonsense as to some new devices being employed at that station which were supposed to be used in sending out messages by means of a special time-spacing system between the dots and dashes, as well as by varying the length of the dots and dashes themselves, which latter make up the telegraphic alphabet. Such a thing is, of course, not impossible, but why should it be done if much simpler means are at our disposal?

Let us imagine the following: A German spy is located on the ocean liner *Adriatic*, headed for Liverpool. When the ship is two days out the spy learns that the ship, on account of submarine danger, will not dock at Liverpool but at Greenock (Scotland) instead. This is important information. Within ten minutes he has sent a wireless to a stockbroker in New York as follows:

H. P. Frye & Co.,
235 Wall Street, New York.
Sell at once 2,000 *shares U. S. Steel at* 58.
John Miller.

When Frye & Co. receive the message they consult their code book and find that it reads thus:

Adriatic will dock at Greenock.

Within twenty-five minutes after John Miller handed his message to the operator on the *Adriatic* Sayville has received and dispatched the following message to its Nauen (Germany) station:

F. S. Schneider & Co.,
Friedrichstrasse, Berlin.
Cannot dispose 2,000 *shares U. S. Steel at* 58. *Are bid* 55½. *Advise.* *Frye & Co.*

This message is promptly received by the German commander of the submarine U-69, bobbing up and down not far from the south coast of Ireland.

He also consults his code book and deciphers the harmless message thus:

Adriatic will dock at Greenock next Tuesday.

With this intelligence the German submarine commander is enabled to change his course in order to successfully hunt his quarry.

This is only one of the ways how the wireless stations at Sayville and Tuckerton can be used successfully to violate our neutrality; there are undoubtedly scores more.

In view of the above it is not quite clear how the United States Government, even by exercising the greatest care in censoring messages, can hope to prevent at all times the dispatch of unneutral wireless messages.

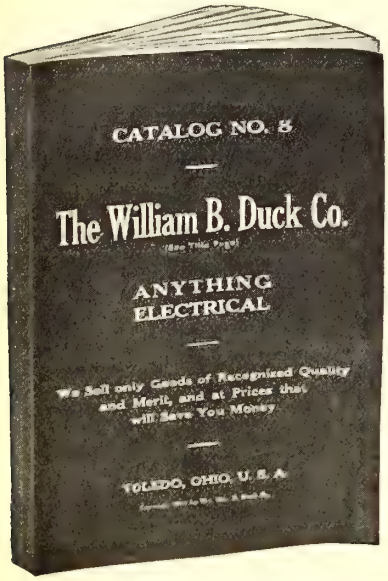
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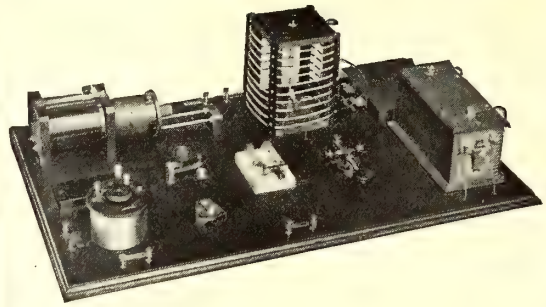
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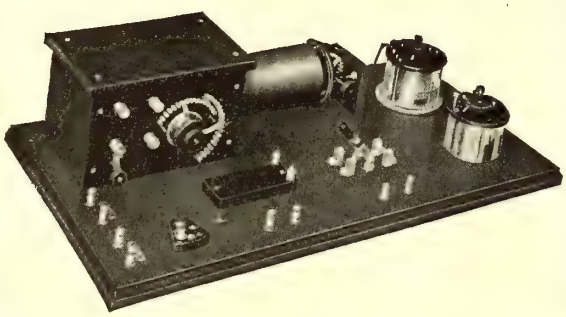
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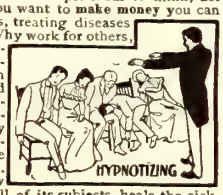
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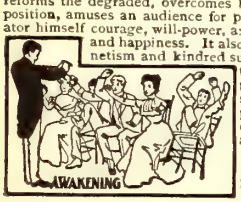
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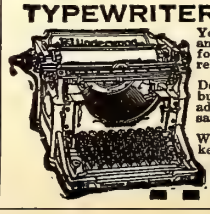
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Vol. III. Whole No. 28 AUGUST, 1915 Number 4

Television, or The Projection of Pictures Over a Wire

By H. Winfield Secor

PROBABLY there is no more interesting, and as yet unperfected, branch of science than that of *Television*, or the process of transmitting and reproducing a scene or a person's likeness over a wire, such as a telephone circuit, so that, for instance, a person telephoning over a line can see on a screen in front of him the person to whom he is talking.

There have been many attempts made to solve this fascinating problem. Several European scientists, including the late E. Ruhmer, of Berlin, succeeded in constructing such an arrangement for the simultaneous transmission and reproduction of living pictures over a wire by utilizing a great number of selenium cells, mounted very compactly in a small flat area.

Selenium, as we know, changes its electrical resistance proportionately to the amount of light thrown on same. Therefore, as every picture is made up of light and dark shadows, it is evident that if such a picture is properly projected on a group of selenium cells that the different cells will change their electrical resistance proportionately to the amount of light projected on them and corresponding conjointly to the light and dark shadows of the view before the instrument. Simply explained, this system works as follows:

Each selenium cell on the transmitter would be connected up with its individual lamp (very small, of course), and thus it is perceived how, at the receiving station a picture or view could be reproduced in black and white and intermediate tones, for the reason that each selenium cell would allow a different amount of current to reach its individual lamp.

This may seem a little ambiguous or complicated to those not familiar with the subject, but what we are driving at may be the more readily perceived or understood by inspecting Fig. 3A. The portrait photographed, reproduced by the half-tone process, exhibited at Fig. 3A, is photographed onto the copper plate used in printing the reproduction on this page, through a finely ruled glass screen. This screen therefore causes the original photograph to be broken up into many small dots. The illustration here referred to, for instance, has about 140 dots to the inch. By looking in an ordinary manner at the photograph here reproduced, no distortion is noticeable, and the picture appears quite natural. Nevertheless, *it is made up entirely of dots.* You can convince yourself of this by inspecting our illustration with a good lens. This brings out the logic of the argument previously referred to, viz., that it is possible, theoretically and practically, to make a machine that will reproduce a picture by such an arrangement of dots or points; whether all of the dots necessary in building up the picture are simultaneously thrown on the screen of the Television apparatus, or whether these dots are successively or very rapidly thrown on the screen, one after the other.

The second view, at Fig. 3B, shows a largely magnified portion of the (marked) eye on the face of the half-tone cut. This shows how the reproduction of the face is made up of small dots, and by closely looking at any newspaper illustration, which is usually photographed through a coarse screen, this *dot make-up* of the picture will be very evident. Some illustrations in magazines and books, which are reproduced on highly polished and specially coated paper, are photographed through such a fine screen that the keenest eye cannot perceive any break-up or dot formation.

As aforementioned, a number of work-



Fig. 1, at Left, Shows Image of Man at Right Being Transmitted and Reproduced on Screen in Front of Lady. Her Face is Transmitted and Reproduced at Fig. 2 (Right) Before Man. Mr. A. A. Campbell-Swinton's Scheme.

THE ELECTRICAL EXPERIMENTER is published on the 15th of each month at 233 Fulton Street, New York. There are 12 numbers per year. The subscription price is $1.00 a year in U. S. and possessions. Canada and foreign countries, $1.50 a year. U. S. coin as well as U. S. stamps accepted (no foreign coins or stamps). Single copies, 10 cents each. A sample copy will be sent gratis on request. Checks and money orders should be drawn to order of THE EXPERIMENTER PUBLISHING CO., INC. If you change your address notify us promptly, in order that copies are not miscarried or lost.

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ers have endeavored to solve this problem of "seeing over a wire," as it is commonly referred to, and one of the best methods tried in a laboratory, on a crude scale, is that of making use of a large number of selenium cells.

However, there are several drawbacks to this solution of the problem, some of them being enumerated below.

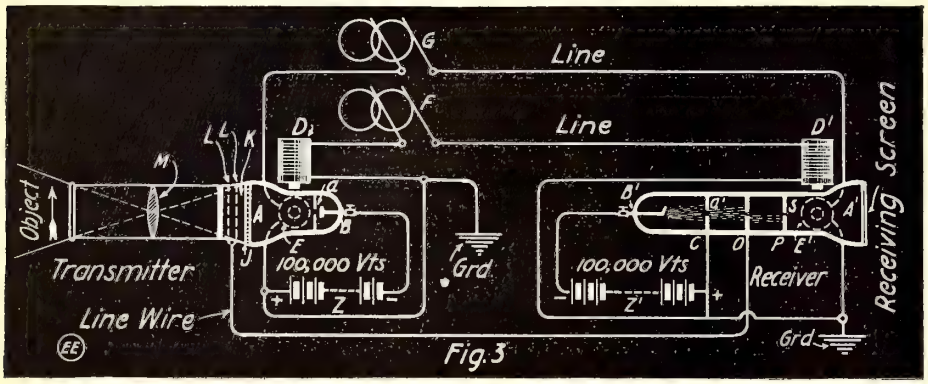


Fig. 3. Diagram of Proposed "Television" Scheme.

Selenium cells manifest a quality known as "time lag" in their electrical operation or action, and this means that it is difficult to build any such apparatus, as we now have under consideration, to act in an anywhere near perfect manner, when the selenium cells will show varying degrees of "time lag," or, in other words, when they tend to be sluggish in their action of changing from high to low resistance, etc. This lag is small, of course, and it must be understood that in considering the basis of this whole process that with the dot formation, even though made up of a vast number of small lamps, compactly grouped at the receiver end of the line, that the changes in the lamps' intensity, which is of course primarily dependent upon the action of the selenium cells on the transmitter, must be quite rapid, and this may be more readily understood when it is known that in the ordinary motion picture, with which we are all familiar, there



Fig. 3A. This Picture Is Made of Many Small Dots, Although You Wouldn't Think so. Note Marked Eye in Fig. 3B.

are from 16 to 20 different pictures projected on the screen per second. This has been found to give us a fairly steady picture owing to the "lag" of the human eye in perceiving an object in motion. That is to say, the eye does not loose its impression simultaneously, but the object's impression on the retina of the eye remains for a fraction of a second, and this explains how motion pictures are made possible by the present methods in vogue.

It has been estimated by a well-known English authority and scientist, who has worked along the line of Television, that if the selenium cell process was to be used to give good close-grained results on a surface only two inches square, there would be required 150,000 wires, 150,000 selenium cells, 150,000 lamps. While even to obtain an effect no better than that used in the coarsest process blocks, as used by ordinary daily newspapers, there would be required at least one-tenth that number of selenium cells, lamps and wires.

Working on this basis, but reducing the number of cells, etc., to be used, to a figure of 90,000, this scientist calculated that the cost for a 100-mile transmission circuit, including apparatus at both ends, would amount to the staggering sum of $6,250,000. This considers simply a monochrome reproduction in black and white only of the view or object over the circuit. If the apparatus in question should have to be triplicated, so as to give a colored picture, by the well-known three-color process, then the cost would naturally rise to three times the amount stated.

From this figure it is to be seen that evidently such a solution of the problem is far beyond us and not capable of industrial or practical applications, in the strict sense of the word.

Some workers in this field have also devised or advocated at different times very clever and ingenious methods, which seem quite good theoretically, for using a less number of selenium cells, lamps, etc., but to gain the same effect as if a large number of cells were used, by suitably moving a beam of light over the various cells successively at very high speed, and some similar arrangement being used at the *lamp* end of the circuit, where the picture is to be reproduced. This would act upon the principle of the retina retention of impression, as previously mentioned, and such ideas are based upon the theory that with proper apparatus, which unhappily is nearly impossible to construct from a mechanical standpoint, that each cell could be used for a fraction of a second.

One of the latest and most promising (theoretical) systems of Television—the *Telephot*—or the instrument for "seeing over a wire," makes use of a stream of cathode rays, which can be deflected and changed in their direction of production very rapidly, and moreover, these rays possess an infinitesimal amount of momentum or mass. This method has been brought forth by an Englishman, Mr. A. A. Campbell-Swinton, president of the Röentgen Ray Society, of London.

The apparatus based on his descriptions and ideas are shown in the illustration at Figs. 1 and 2. In this picture detailed apparatus only is shown for transmitting pictures one way, or, in this case, from right to left; the detailed receiving apparatus being then at the left of the picture and the transmitting apparatus with high frequency A. C. generators, etc., being shown at the right. Both transmitting and receiving tube openings are shown, however. It is evident that one can easily, and without any awkward motions, glance slightly upward to view the reproduced face in the smaller upper screen, which is shown placed at a small angle. A dictagraph or super-sensitive telephone transmitter is probably best for such instruments and is observed under the *television screens.* Six wires are required to transmit pictures both ways.

We may now briefly consider the operation of this apparatus advocated by Mr. Campbell-Swinton, and which has been favorably received by the scientific world, *although as yet not practically demonstrated.* The schematic diagram, Fig. 3, will help the reader to understand the diagnosis of its operation. Three line wires are necessary between the apparatus, as observed from the illustrations at Figs. 1 and 3. At the *transmitter* end of the line there is used a focusing lens barrel "X." The object whose reproduction is to be electrically transmitted over the line is arranged at the tube opening, as at "N." A Crooke's vacuum tube is used at "A" and at "B" is the cathode electrode of the tube, from which the cathode rays are shot forth at an incredible velocity and which have

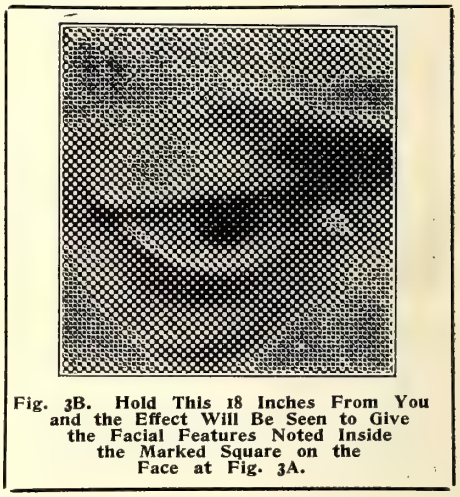


Fig. 3B. Hold This 18 Inches From You and the Effect Will Be Seen to Give the Facial Features Noted Inside the Marked Square on the Face at Fig. 3A.

practically no mass or momentum. An anode "C" of circular form is placed in the tube, which has at its center a small aperture or opening "a." Through this opening a small stream of cathode rays may pass; these rays being produced by a high potential *continuous current* from a source "Z," giving in the neighborhood of, say, 100,000 volts. Placed at right angles about the tube "A" are two electro-magnets "D" and "E," and these are energized by alternating currents from the A. C. generators or dynamos "G" and "F." These magnets allow of readily controlling or deflecting the cathode rays stream in a vertical and horizontal direction, respectively.

At "J" in the transmitter tube is placed a special screen, the whole surface of which is searched out by the stream of cathode rays, every tenth of a second, under the combined action of the A. C. electro-magnets "D" and "E." It should be mentioned here that the dynamos "G" and "F" produce *widely different* frequencies of alternating current; one of them producing, say, 1,000 complete positive and negative alternations per second, and the other 10 such complete alternations per second. The special screen "J" is proposed to be a gas-

(*Continued on page* 172.)

Submarine "Wireless" Signaling

THE subject of safety of submarines at sea is of vital importance, especially in the present submarine warfare, in which many of these under-sea fighters are participating.

It is well known that wireless telegraphy is now the most important factor of communication on our present ocean steamers and battleships, which aids their navigation and safety at sea; but when we come to the submarines, the wireless used on these craft cannot now be directly adapted to the under-sea fighters, as the etheric waves produced by the ordinary wireless apparatus cannot travel very far in water, and therefore other means of signaling becomes necessary. Many forms of apparatus were invented and used with considerable success, such as the submarine bell, which is still in service; but the distance traveled by the sound is so small that it is practically useless.

These methods were rarely used, however, until finally an Austro-Hungarian physicist, H. Christian Berger, who realized the necessity for an efficient means of submarine signaling between moving under-sea vessels, devoted his talents to the solution of the problem. He finally solved the problem by using the principle of longitudinal vibrations in a steel wire or strip set into vibration by frictional means.

His first transmitter consisted of a piano wire, as at A in Fig. 1, which is here shown a ribbon of only 2 millimeters diameter, set into longitudinal vibration by a hand-driven silk wheel B moistened with alcohol; D is a sounding chamber, which is immersed in the water. With this apparatus Morse dot and dash signals were clearly heard for 3 kilometers (1.86 miles). The sound had the qualities of the ordinary etheric wireless, and it has therefore been called submarine wireless.

These experiments were conducted on the United States submarine E-1, and were so successful that the United States officials were encouraged to build a large apparatus, using a ½-horsepower electric motor C, Fig. 2, to drive the exciter, and also the wire was substituted by a flat metallic ribbon having a thickness of 1/8 inch and a width of ½ inch.

The complete apparatus is shown in Fig. 2. A commercial type Morse key, Fig. 3, operates a magnetic clutch D on the shaft by pressing the key, thus supplying current to the electromagnets in the clutch and connecting the worm gear in case E, which is connected in turn to the felt-edged wheel A. This wheel contains a reservoir inside it, in which alcohol is placed in order to feed the felt continuously.

The operation of same is as follows: The clutch is connected and the steel ribbon is next stretched and placed near the felt wheel so it touches same. The motor is next started by pressing the Morse key. The felt wheel is set in motion, according to the current sent through the magnetic clutch, which is operated by the key and consequently produces friction on the ribbon, which is caused to rapidly vibrate. These vibrations are sent out on air waves and cause the hull of the boat to vibrate, and finally are communicated to the water. The water is thus also set into vibration and these vibratory tones are received by another vessel containing the proper receiving apparatus. The distance that these waves travel depends entirely upon the number of vibrations which the steel wire or ribbon emits.

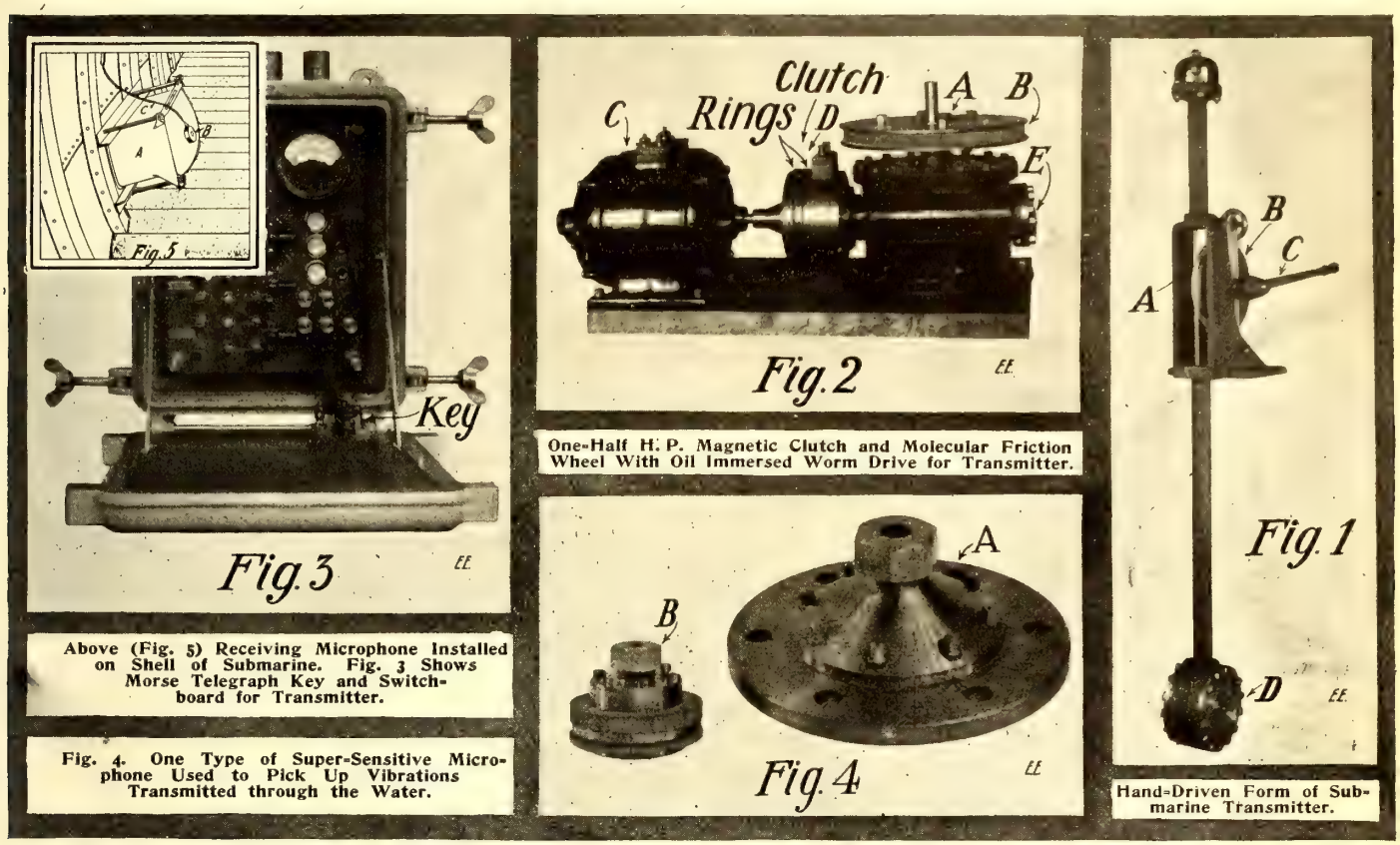
The receiving apparatus consists of a receiving tank, super-sensitive microphone, telephone receiver and battery. The receiving tank is placed on the hull of the boat as shown in Fig. 5 at A, and it is filled with water. The microphone transmitter B, Fig. 5, is placed in firm contact with the receiving tank and connected in series with a telephone receiver and battery by water-proof copper wires. The transmitter is then covered with a thick steel plate A. See Fig. 4.

The incoming waves or vibrations caused by the transmitter are caught by the receiving tank, and the microphone intercepts these faint vibrations, which vary the resistance in the telephone circuit, thereby giving the exact sounds as produced at the transmitting station. The water in the tank acts as a conducting medium between the hull of the submarine and the sensitive microphone transmitter, just as the ether acts as a conducting medium in aerial wireless telegraphy.

With this system signals were audibly read at a distance of 10 knots. The secret of the extraordinary efficiency of this system lies in the fact that the vibrations used are longitudinal and the stresses set up molecular. Unlike a plucked violin string, where the pitch depends on the tension, the pitch in longitudinal vibrations is independent of its tension.

As friction is always rhythmic, the exciter or felt wheel throws the wire into intense longitudinal oscillations, and a clear and absolutely uniform musical note is produced in the water. In order to produce a note of 1,000 vibrations per second, most suitable for microphones, the wire is cut for one-half a wave length. As the velocity of sound in steel is about 16,000 feet per second, the wire would be 1/2,000, or about 8 feet in length, and this would generate a sound wave of about 4.7 feet in water. So it must be quite evident that to transmit these vibrations for eight or 10 miles a longer wire must be used, or else a shorter wire having a greater tension. Therefore more power is required to set this wire in vibration.

This method of signaling has been approved by marine officials, and many of these apparatus are being used by Uncle Sam's submarines, with good success.



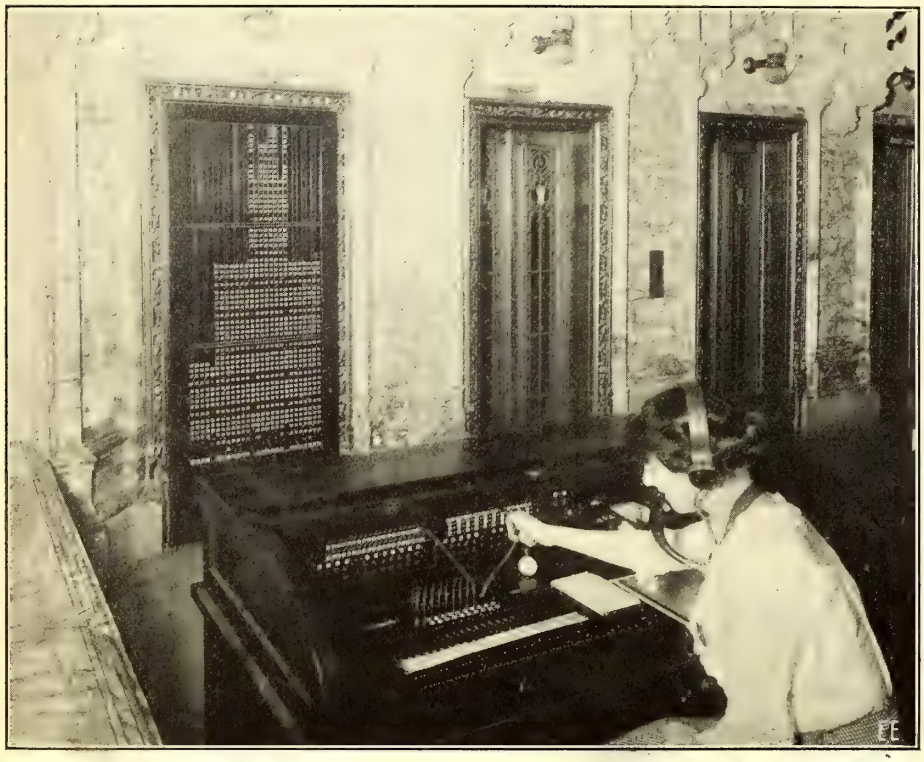
Above (Fig. 5) Receiving Microphone Installed on Shell of Submarine. Fig. 3 Shows Morse Telegraph Key and Switchboard for Transmitter.

Fig. 4. One Type of Super-Sensitive Microphone Used to Pick Up Vibrations Transmitted through the Water.

ELECTRIC ELEVATOR CONTROL AT THE WOOLWORTH BUILDING.

One of the most striking objects at the Woolworth Building, in New York City, is the automatic elevator control, which is depicted in the accompanying photograph. The switchboard here seen is not a control board, similiar to that in an ordinary power house, but entirely new. It contains many small electric lamps, placed in a number of vertical rows, each row corresponding to an elevator, and the number of lamps in a row corresponding to the number of floors which that particular "car" covers. In this way the operator can readily see just where any of the 27 cars are located in all sections of the building. There are also a number of jack switches on the desk connected to telephones installed in each car, by means of which communication with any particular motorman is easily effected.

This system is very simple and works splendidly in large buildings where many elevators are in operation. Elevator dispatching is thus reduced to a science in the modern skyscraper.



This Girl, by Means of a Lamp Signal Board as Shown, Has Complete Control of the 27 Elevators in the Woolworth Building, New York City.

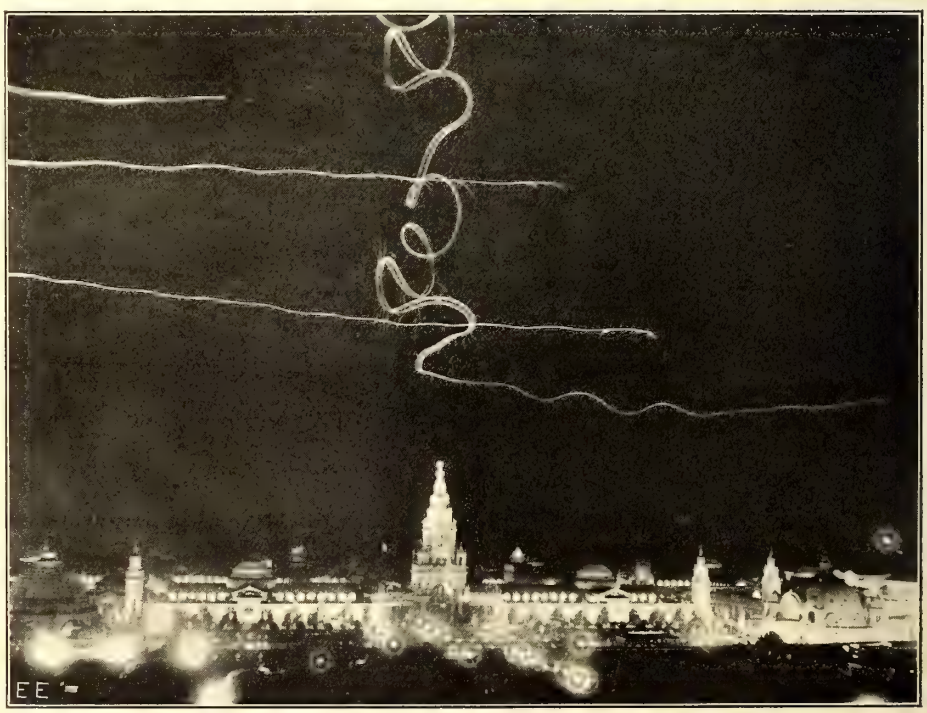
ILLUMINATED AEROPLANE GIVES SPECTACULAR EFFECT.

This is a bona fide negative taken of an illuminated aeroplane flight made by Art Smith, the "Upside Down Aviator," flying at night over the Panama-Pacific International Exposition in San Francisco. The picture was made from a single timed exposure on the night of May 27, and is now published for the first time. The shutter was exposed during the period of the flight.

The picture is unique, as it is the first photographic record of an aeroplane's course ever made on a single negative. While the course of an aeroplane may be recorded by a cinematograph film, a night exposure obviously is the only one capable of recording the course of an aeroplane on a single plate. A daylight exposure would show the aeroplane at but one point.

Owing to the high speed of the aviator's flight and the fact that only a portion of the aeroplane was illuminated the course of the flight only is marked on the negative, the aeroplane itself having escaped the camera. The parallel lines were made as Art Smith flew back and forth over the exposition grounds while gaining a height from which to loop the loop and turn the side spirals of which he is a master. These parallel lines apparently start or end in the dark, as from time to time the aviator shuts off the light from his aeroplane. The trail of light is caused by the flow of brilliantly illuminated white smoke and a discharge of white fireworks from a non-explosive smoke pot at the back of the aeroplane.

The lines above the Tower of Jewels, in the center of the picture, were taken as the boy aviator, with his aeroplane fully illuminated so that the thousands below might observe his flight, looped toward the earth. These lines show four distinct loops, in which the aviator turned complete circles in courses vertical to the earth and one back "upside down" loop.



Illuminated Aeroplane Describes Wonderful Effects Against Night Sky of 'Frisco Exposition.

HOW ELECTRICITY KILLS.

Ever since electricity was first used it has been known that under certain circumstances it was deadly, but just what these circumstances were and how electricity kills took almost endless experimenting to find out. The mystery of electricity's deadly power seemed to be one of those unanswerable problems which deal with the question of life and death, but now, thanks to the tireless energy of many scientists, the various results of their observations have brought the answer.

In the case of an electric shock severe enough to kill, death usually results from one of two causes—either from paralysis of the respiratory organs or from contraction of the muscular fibers of the heart. In the former case, the victim may occasionally be literally brought back to life by artificial respiration, but there is no known remedy in the latter case.

The effect of direct and alternating currents vary with the current strength, the duration of contact and the path through the body.

Lower animals are much more susceptible to electric shock than mankind, dogs being frequently killed by a direct current as low as 70 volts. The average man can take a direct current of 100 volts and scarcely notice it; 200 to 400 volts give rise to muscular cramp, while respiration is suddenly stopped at 550 volts. At 600 volts both contraction of the heart and respiratory paralysis begin, but at 2,300 to 4,800 volts the effect is usually confined to the respiratory organs. The electrocution records of various American penitentiaries show that two to seven amperes at 1,500 volts, 15 to 50 cycles per second, always stops the heart when continued 45 or 50 seconds.

A NOVEL DENTISTS' SIGN.

A clever advertising sign was recently made for an Eastern dental parlor. It is indeed unique and never fails to arrest the attention of the passing crowds.

This sign is an electrically operated *human jaw,* as seen in the photograph Fig. 1, and it consists of two parts, namely; the lower and upper jaws. They are constantly opening and closing. This is done by means of a one-eighth horsepower electric motor connected to a suitable gear which is linked up to the lower jaw frame. A large number of incandescent electric lamps encircle tis sign, which are lighted at night. Fig. 2 shows the sign when the jaws are open.

The size of the sign is 30 inches high, five feet wide and five feet deep, and the distance between the jaws when they are fully opened twenty inches. It weighs 400 pounds. Photos by courtesy of the Federal Sign System.

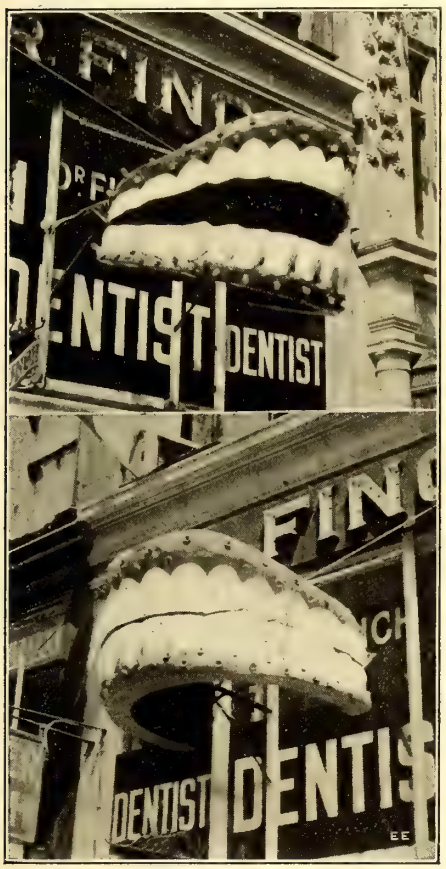


Fig. 2 (Above) Shows New Electric Dental Sign With Jaws Opened. They Open and Close Repeatedly; Fig. 1 (Below) Showing Them Shut.

CORRECTION ON TALKING PICTURE ARTICLE.

With reference to the article entitled "Talking Motion Pictures and Selenium," published in the June, 1915, issue of *The Electrical Experimenter,* we are informed by Ignatius H. McCarty, of San Francisco, a well-known wireless and electrical engineer, that he has done similar work to that mentioned by S. Wein in his treatment of the subject, and also he suggests that many details not mentioned in the article have been worked out by himself and his associates, necessary to the successful commercial application and adaptation of this ingenious scientific idea.

Mr. McCarty has been granted a basic patent on this method in France on September 26, 1912, the number of the patent being 448,757, and his United States basic patent bears application serial No. 701,219.

It is also stated in his communication that, in the apparatus used in his system, the speech accompanying the motion pictures is so perfect that it does not at all resemble a phonograph, and does not possess that "tin-canny" effect always so noticeable when the usual phonograph is used with a horn on same, or even when a number of horns are used. Also, this inventor claims to have invented a telephonic transmitter suitable for wireless and other work, which does not use any carbon, but instead a compounded product developed by himself, and which substitute is pronounced absolutely free from carbon, after chemical analysis. It is said to be far superior to the ordinary carbon transmitter, and is shortly to be tested out over the New York to San Francisco long-distance telephone circuit. It has also been tested with wonderful results over circuits 75 to 100 miles long, and works better in every way than the common carbon-grain transmitter.

Edison 3,000,000 C. P. Storage Battery Searchlight

Profiting by an experience of firemen in fighting the $3,000,000 fire at the Edison Works at West Orange, N. J., on Dec. 9, 1914, Thomas A. Edison has perfected another invention which he took to his home in Llewellyn Park recently to try out.

A few minutes after Charles Edison began operating the device for the edification of his father, people living in the valley east of Llewellyn Park telephoned Police Headquarters and asked, "What is that terrible light shooting out of the park?"

A policeman found Mr. Edison and his family enjoying the wonders produced by a new 3,000,000-candle-power searchlight, capable of throwing a ray several miles, the most powerful portable searchlight yet invented. It is very small and the power is supplied by storage batteries.

In the fire at the Edison plant the yards were thrown in darkness when the power was shut off. Mr. Edison conceived the idea of a portable searchlight, and two days after the blaze he had designed a working model. Now he announces the perfection of his idea.

It was said at the Edison laboratory that the lamp will be very useful in mine rescue work, at fires, and on ships, aeroplanes and locomotives. It can produce light in any volume desired, involving a new principle and making it of marvelous efficiency. A specially made incandescent lamp of high candle power is used in it.



(C) By International News Service.

Thomas A. Edison Inspecting His New 3,000,000 C. P. Storage Battery Search Light.

MAKING TELEGRAPH RELAYS ACT AS SOUNDERS.

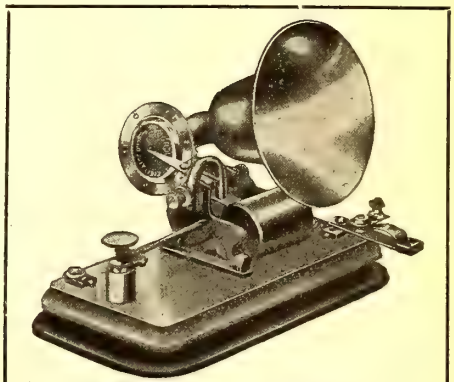
This is an age of improvement; new inventions for the betterment of the conditions of mankind and for his convenience are of almost daily occurrence.

Until quite recently, however, they have seemed to labor under the impression that the electric sounder had reached the perfect stage—that the local battery was a permanent fixture.

The new diaphragm telegraph sounder does away with both electric sounder and local battery. It is attached to the relay, and works from the main line battery.

Many devices have been employed with a view of making the relay loud enough to read without a sounder, but the device here pictured is claimed to be the only instrument that actually creates additional sound and intensifies it to practically any degree desired.

The concussion takes place within the air-tight diaphragm starting the vibration through the intensifier similar to the reproduction of the human voice by the phonograph. It has a strong, easily read, non-metallic tone that can be read with accuracy at a distance of a city block, and the adjustments may be so varied that no two instruments need sound alike.



New Amplifone Horn Converts Any Telegraph Relay Into Sounder.

Baron Münchhausen's New Scientific Adventures

By Hugo Gernsback

The Earth as Viewed from the Moon

I am in receipt of the following letter, postmarked Red Dog, N. M. It runs as follows:

deer (?) *mister i. m. alier,*

i am onely a uneducatet cowboy & perhaps i aint much sens but hear i have been reeding those gosh-darned münchenhaus storys of yourn & i am all het up about em i an my pal mike cokkleberry has tryed making hed or tale out of em but it aint no use

the first storys werent kwite so bad but they getting fierse as you rite more of em but you kapped the klimaks as mike sais when you rave about this graviti busness an try to mak us believ that a objeck between here and the moon weihs nothin at all a pound is a pound isnt it anywere? an mike sais that he lernt in scool that a lb of lead weihs as much as a lb of fethers, so mike figgered if that is true well then how coud you weih 28 lb on the moon if you weih 170 lb on the erth a lb is a lb isn't it? gosh darn nonsens it is thats what i sais it is an you now it is we may be igorant out hear in the wooly west but we aint that kracked yet by a darnsite that aint all, when mike & i red about that münchenheimer of yourn shoting rocksalt at them germins so they had to skratch themselfs which made them throw up their hants we sure thoght that it was a grate trik an we tryed it on bad man rogers when we sees him last weak we didnt wish to kill him ded just wanted to hav some fun & watch him skratch hisself when the rock-salt got under his skinn

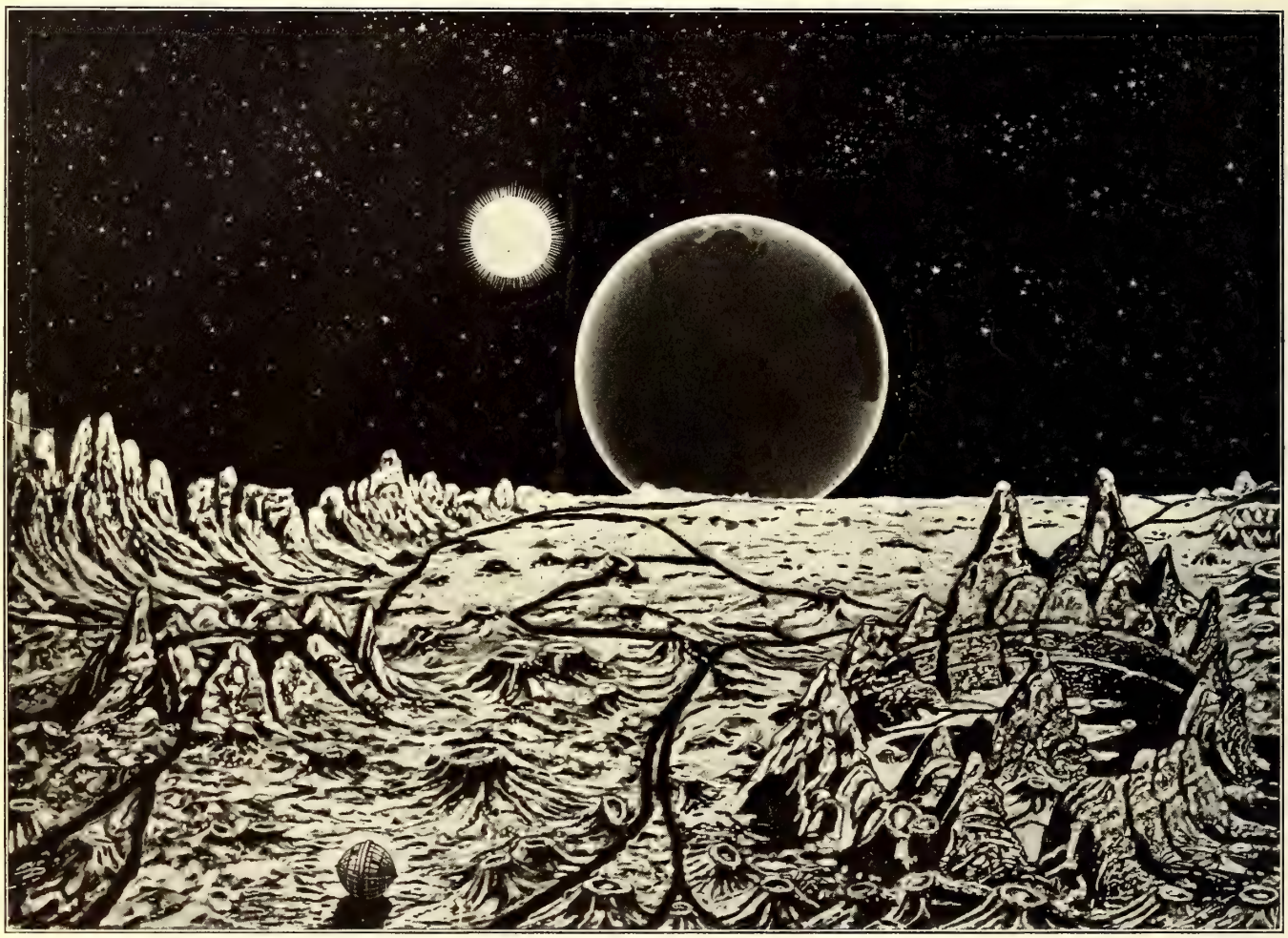
so we lays for rogers near bulfinsh crik when he koms riding that there evening on his way to ed sweezys place sos he woudnt now from where we ambushd him we had fixt a maksim silenser on our rifels an insted of bulets we use your rocksalt to shoot at him well everything goes loveli he koms all stuck up as usal on that fool hoss of hisn an when he is jest bi we pot at em mike at his leg i at his bak the guns go fss-sst—fss-sst and thats all but he must have herd the klik of our guns and he weels around in his sadel but instead of skratchin hisself in a agoni as he should he sneeses and sneeses and sneeses fack is he almost sneest his fool hed of after a wile when his sneesing gets weeker an his swaring louder he looks around suspishes like but he dont see us an so he rides on after awhile

mike an i looks at each other flabergastet like and mike sais sais he, i had my suspishen of that feller alier now i now he is a fake darn his hide i thoght so to so we tryd it again & shot the salt again our windo pane when we git home wel would you believ it the salt never even touched the pane at all but when mike goes to inspeck the windo he almos sneeses his hed of that put us wise to it that when you shoot rocksalt from a gun it pulverises instinktly and the fine salt hangs in the aire around like a cloude of snees powder an when you git near it it gits in your nose an then you snees till the cows come home.

well maibe our salt wasnt as good as your frenchy kind & maibe we shoudnt of used a silenser on our guns but jest the same as a frend i adwise you never to kom out here to red dog for mike an i wont try rock-salt on you we'll use *reel* rocks

yours in disgusd

Bill snikeltree



. . . . At This Minute It Is NEW EARTH For Us On The Moon . . . . (C) E. P. Co.

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s.p. mike sais your name ougt to be U.R. alier not i. m. alier.

* * *

When I had established my wireless connection with Baron Münchhausen that evening I immediately read the above letter to him and demanded an explanation. The Baron merely chuckled softly and said:

"My dear Alier, you ought to know better by this time than to doubt my word. I am always glad to give details of any general statement I might make at any time. In this instance let me state that your correspondent, who seems to have but a limited education, is, of course, right as far as he goes. My first experiments with shooting rocksalt were exactly as stated by your cowboy friend: the salt *does* pulverize before reaching the enemy—that is, *ordinary* rocksalt does. Not the kind, however, that I used for the French and English Allies. For when I found out that ordinary salt went up in dust when shot from a gun I promptly set out to remedy this defect. I simply ground up the rocksalt and by means of a chemical binder I formed a stiff paste; this was then compressed hydraulically in dies under an enormous pressure into little sharp-pointed bullets about ½ inch long. After drying, the bullets were ready to be used by our soldiers. These compressed rocksalt bullets did not pulverize, and while they had not the great penetrative power of an ordinary bullet, they accomplished the purpose for which they were intended very well indeed. I hope I have satisfied you and your correspondent's curiosity."

I apologized meekly to the Baron for having doubted his word, after which I added:

"The public down here, Your Excellency, has been very much impressed with your recent adventures on the moon. I am daily in receipt of correspondence from people from all parts of the world desiring particularly to know what the appearance of the earth is as seen from the moon. Many wish to know if large cities and rivers can be seen, and some even go as far as to ask if you can see trains and people move about the surface of the earth. Large bets are being made by people on the above subjects and the newspapers are being besieged for information day and night. They all have now put it up to me to procure first hand official information from you, and I trust you will be good enough in helping me to relieve the abnormal tension."

I heard Münchhausen laugh softly before he replied:

"Well, well! I would never have believed that people take such an interest in astronomy, but it certainly shows signs of progress by the human race and it is worth encouraging.

Without desiring to deliver a dry, astronomical lecture, I think it best to state a few fundamental facts in order that I can make myself better understood. Anyhow most people's astronomical knowledge is rusty nowadays. Therefore I hope I shall not bore you unduly.*

HAS it ever occured to you how the earth would look to you if viewed from the moon? Did you know that it is *new earth* on the moon when it is full moon on earth? If you don't know these things—and you certainly should know them—let Münchhausen tell you.

In this instalment he gives you true scientific facts in plain English. The story makes twenty minutes of pleasant as well as instructive reading.

The moon is about 240,000 miles distant from its primary, the earth. It revolves about the latter in 27¼ days, always turning one side to the earth. For this reason the inhabitants of the earth can never see more than one of the moon's hemispheres. Thus the moon revolving around the earth in 27¼ days turns just once around its axis during this time. Consequently the length of the moon's full day is 27¼ terrestrial days, which gives it a night of almost two of our weeks, as well as a day of like duration.

Now let us turn our attention toward the physical aspect of the earth as viewed from the moon. I am now sitting at the foot of a precipitous mountain close to the bulwark *Ptolemäus*, which is near the moon's equator. When I lift my eyes earthward I am presented a wonderful spectacle such as no other human eye has ever beheld. At this minute it is *New Earth* for us on the moon, i. e., the sun, earth and moon are in line, in the order named. As the earth is almost between us and the sun we naturally cannot see much of the former. For inhabitants on the earth it is *full moon* at this minute of speaking. In other words, when it is full moon on earth it is *new earth* on the moon; when it is *new moon* on earth it is *full earth* on the moon.

(To make the above plainer for the reader the author has inserted the accompanying diagram and the following explanation:

The plain line represents the orbit of the Earth; the dotted line represents that of the Moon.

At point A the Moon crosses a point of the Earth's orbit which the Earth has already passed. At the expiration of about one-fourth of a lunation she arrives at B, at which time the Earth is between the Moon and the Sun, consequently it is *full* moon; pursuing her course she is now in advance of the Earth and crosses her orbit again at C. From C she continues on her course till at D she is between the Earth and the Sun, consequently it is *new* moon; from D she approaches near and nearer to the orbit of the Earth till at G she again crosses it 240,000 miles behind the Earth. This completes one lunation or revolution of the Moon around the Earth.

In order to show how the Earth and the Moon are lighted up by the Sun the zig-zag lines around part of the Earth and the Moon in the diagram represent the portions which are lighted. Thus it will be readily seen that at A the Moon is in its *first* quarter as respects to the Earth, while the Earth is in its *last* quarter as seen from the Moon. At C this order is reversed.

Again at F we see a duplication of the phases exactly as occurred when the Earth and the Moon were in the position as shown at A.)

Now, then, as the sun shines on our full moon the sunlight is reflected down to the earth, half of which naturally is dark. i. e., night. It is now night for you, the moon lighting up your landscape. For this reason it is possible for me to *just faintly* make out the outlines of the American continents. But it is mostly blurred and very indistinct.

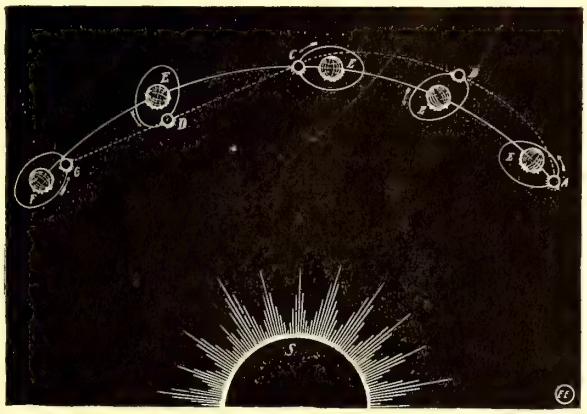
A little to the left of the earth I see the sun—a wondrous sight. As there is practically no atmosphere on the moon the earth as well as the sun sail in a pitchblack sky. For the sky on earth is blue only due to the terrestrial atmosphere and its diffused sunlight. On the moon there being practically no diffusion our sky is naturally black all of the time. The sun, as well as all the stars, shine with a tremendous brilliancy never seen on earth, for our little atmosphere cannot soften the penetrating glare of the heavenly bodies as does the earth's thick atmosphere. Neither do the stars flicker as seen from here, for the "twinkling" is not of the star's making, it is but a product of the earth's air which brings about this phenomenon.

Again gazing earthward this is what I see:

A big almost black disc appearing to me about 14 times as large as does the full moon on earth; old mother earth assuredly is an imposing sight. Around the circumference of the dark disc I see a wondrous pink fringe—it is the earth's atmosphere illuminated from behind by the sun's rays. It

(*Continued on page* 170.)

*The balance of this instalment is based upon actual facts, according to tne latest lunar researches.—AUTHOR.



Explaining the Phases of the Moon and the Earth.

How Telephone Men Are Trained

TO the layman a telephone instrument is a rather mysterious contrivance. He knows that he has merely to signal the operator in order to talk into the transmitter and send his voice over the wires thousands of miles and through the receiver listen to another voice from many miles away. But the operation of the telephone system is not like that of a locomotive or street car, for example, because we can't see the wheels go round.

So when a telephone man comes to our office or residence to install a telephone or inspect and repair one which may be out of order, we may be pardoned for exhibiting a little curiosity as he deftly does his work. It all seems quite simple to him, however, because he has been carefully trained for this work, and every step has been taught him in a systematic and practical way.

The New York Telephone Co. maintains a plant school at 30 Gold street, New York City, where employees of the plant department are instructed in the work of installing and maintaining telephone instruments and the various methods of wiring, etc. It has been in operation since 1903, when it began in a small way as more or less of an experiment. It has grown steadily and taken its place as an important part of the company's organization, and many telephone men have received their first instructions in the principles of telephone practise here.

The object of the school is to interest and instruct the employees of the plant department in the telephone business, develop their ability to learn circuits and provide them with a suitable foundation upon which to build their knowledge of telephone practise as they gain experience in the field.

The period of instruction covers from 10 to 12 weeks, four weeks being spent in the school. The capacity of the school is sufficient for 50 students.

Three views of the highly developed plant training school maintained by the New York Telephone Co. are shown herewith. The illustration at Fig. 1 shows a general view of the school. Each student sits before a small switchboard with the proper devices on same specially arranged to teach him in the shortest time how telephone switchboards work, and also it is possible for the instructors in charge to throw a multitude of "faults" or troubles on the boards, and the time is then checked carefully which it takes the student to "clear up" all of these troubles. In some cases several hundred "faults," such as short-circuits between wires, grounded wires or cables, bell troubles, relay troubles, etc., can be simultaneously thrown on such a board, and the student is required to quickly clear up these artificially made "faults."

A closer view of students performing this testing and *trouble shooting* on switchboards is seen at Fig. 2. The students, as will be observed, are given personal instruction, and this of course conduces to their rapid education and training. A corps of telephone experts are in charge of the school who are men of wide experience in such matters.

In the illustration at Fig. 3 several students may be observed wiring telephone branch exchange circuits, this being *third grade work*, as it is termed in the school. This is very important work and must be learned exactly and the student must show considerable skill in handling the soldering iron, as many hundred small joints between wires and connecting studs are to be soldered in a very neat and workmanlike manner; or, in other words, the job must be done perfectly from a mechanical and electrical standpoint. A loose joint, caused by improper soldering, can cause a telephone circuit to be worthless for transmitting speech over. Hence, the great importance of training these men to do their work as perfectly as possible. They must know the why and the wherefore of everything.

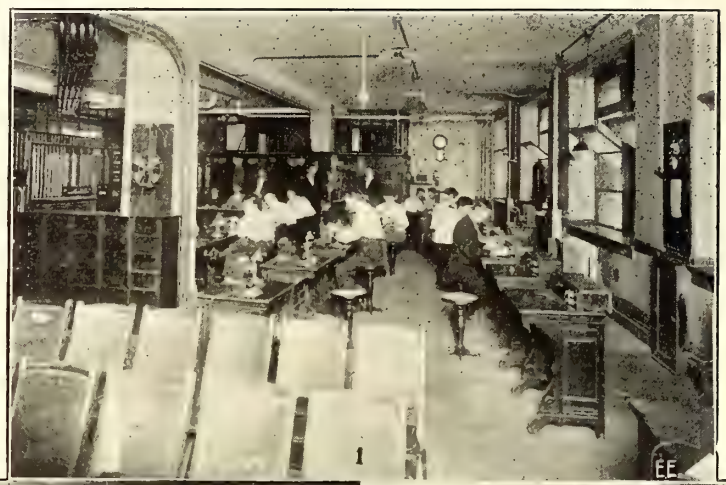






Illustration Fig. 1. Shows General View of the New York Telephone Co.'s Plant School. Fig. 2. Students Testing Sub-Station Instruments For Trouble—Second Grade Work. Fig. 3. Learning How to Wire Up Branch Exchange Circuits—Third Grade Work.

TO HONOR WIRELESS HEROES.

The dedication of the Jack Philips *Titanic* memorial fountain at the base of the tower of the United States Barge Office, New York City, took place last May.

President McAneny, of the Board of Aldermen, received the memorial on behalf of the city. It consists of a cenotaph shaft 8 feet high with seats on each side and a fountain in the center, all of granite, and a background of cypress trees.

The funds to erect the Philips Memorial were collected by the wireless operators on Atlantic and coastwise steamships on both oceans and amounted to more than $3,000. It is intended to have the names of all operators who have lost their lives while on duty inscribed on the cenotaph as a record of their bravery and to inspire others to emulate their example in the time of danger. The names on the memorial are:

George C. Eccels, s.s. Ohio, Aug. 26, 1909; Pacific Coast.

Stephen F. Sczepanek, s.s. Pere Marquette, Sept. 9, 1910; Lake Michigan.

Jack Philips, s.s. Titanic, April 15, 1912; Atlantic Coast.

Lawrence Prudhunt, s.s. Rosecrans, Jan. 17, 1913; Pacific Coast.

Donald Campbell Perkins, s.s. State of California, Aug. 18, 1913; Pacific Coast.

Clifton J. Fleming and Harry Fred Otto, s.s. Francis H. Leggett, Sept. 18, 1914; Pacific Coast.

Adolph J. Svenson, s.s. Hanalel, Nov. 23, 1914; Pacific Coast.

Ferdinand Kuehn, s.s. Monroe, Jan. 30, 1914; Atlantic Coast.

Walter E. Reker, s.s. Admiral Sampson, Aug. 25, 1914; Puget Sound.

Space is left for the addition of other names in the future.

NEW THERMOPILE FIRE DETECTOR.

A fire alarm system consisting of a number of thermopiles which are distributed throughout the building to be protected and which are connected in series to a galvanometer cabinet has recently been placed on the market. Connections are also made from the cabinet to fire alarm bells and to a trouble buzzer. The cabinet contains, in addition to the test resistors, the special galvanometer which is connected to the thermopiles. A break in the circuit, a drop in battery voltage or a total failure of the

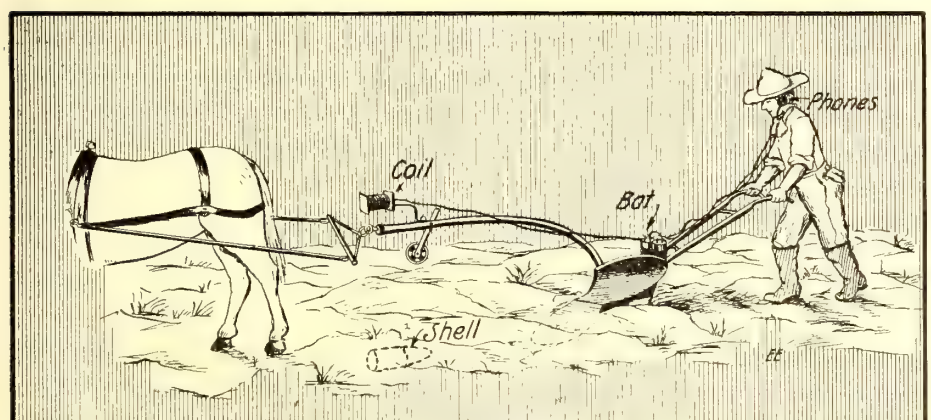


New Thermopile Fire Alarm.

battery will cause the operation of a trouble alarm, which continues until the trouble is remedied. The deflecting pointer of the galvanometer is held in its normal position by the test current in the thermopile circuit. When suddenly energized by current from the thermopiles the pointer is moved into contact, sending in a fire alarm, and when de-energized the pointer is moved into contact for the trouble alarm. The thermopiles consist of cubes of dissimilar metal connected in couples and mounted in porcelain. The joined ends of the couples are exposed, while the other ends are concealed in the base. According to the manufacturer, a temperature rise need not be more than 10 degrees Fahrenheit, but must take place within 60 seconds in order to operate the fire alarm. The alarm will be operated just as quickly whether the temperature of the room at the time of the fire is at zero or at any higher temperature. A single thermopile is designed to operate throughout a maximum floor area of 400 square feet. The maximum distance between centers of thermopiles in general is recommended to be about 25 feet, and in corridors 40 feet.

FINDING UNEXPLODED BOMBS ON EUROPEAN BATTLEFIELDS BY ELECTRICITY.

One of the most dangerous propositions the European tillers of the soil have to contend with under the present war conditions



The Plowman on European Battlefields Uses An Exploring Coil, Attached to the Plow, to Determine the Presence of Unexploded Shells.

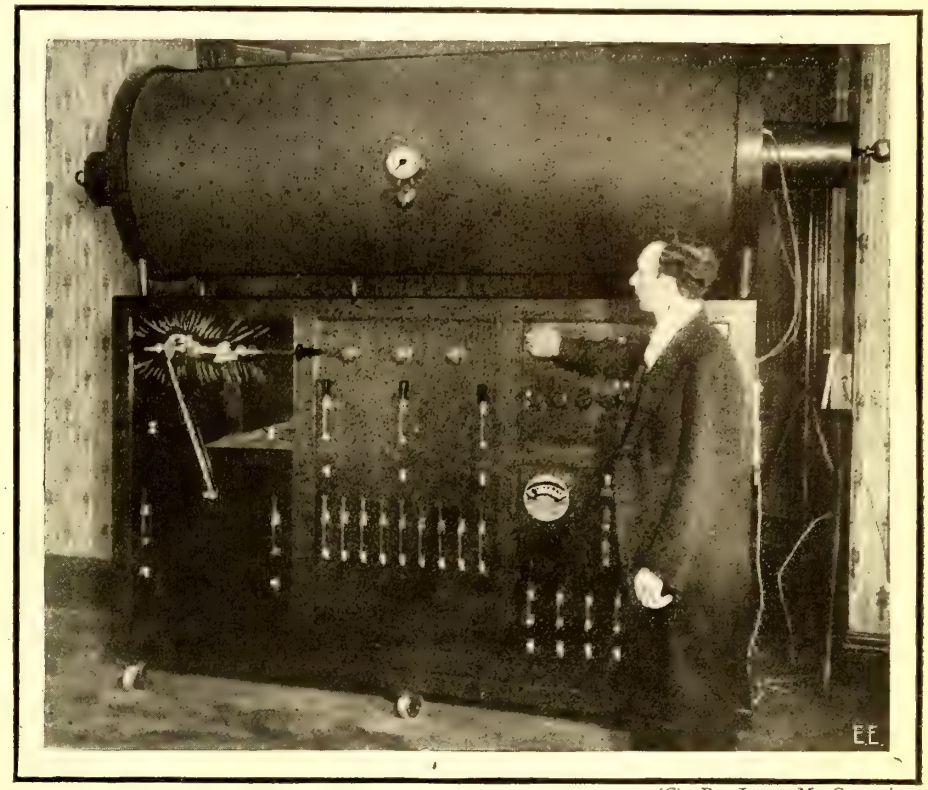
is that of running their plow into an unexploded shell. Most of these shells are exploded, as is well known, by coming in sudden contact with some other body, and, of course, a moving plow forms an ideal means by which to explode such shells, which may have buried themselves several inches in the soil.

To obviate this, there is now being used in France an electrical exploring coil, arranged to extend two or three yards ahead of the plow by being suitably supported on a small arm mounted in front of the plow, the coil being properly excited by a buzzer interrupted current from a battery carried on the plow frame. The man doing the plowing wears a set of sensitive telephone receivers on his ears, and whenever the coil, and conjointly the plow, comes within a couple of yards or so of such unexploded shells (which are made, of course, with a magnetic or steel jacket) a difference in the tone of the interrupted current in the head phones is perceived. He then knows that he should examine the ground carefully.

New Harmless Ray To Do X-Ray's Work.

Every person who has had experience with X-ray work knows of the severe burns which the ordinary X-rays give when worked with constantly. These defects are now overcome by the discovery of a new *ray* by Charles H. Stanley, of New York City. This new ray can be put to the same uses as the X-ray and more, and produces very satisfactory results. It is harmless and does not necessitate the operator "screening" himself in order to perform his work safely, as is the case with the old and dangerous X-ray.

Fourteen years of experimentation and research were expended before this new and harmless ray was perfected. The photograph herewith presented shows Mr. Stanley, the inventor, standing near his apparatus, which consists of a specially designed high frequency coil, producing a tension of one million volts and a discharge between two terminals, which can be separated 39 *feet apart*. This coil is so made that several different frequencies are sent to the X-ray tube, so that the production of the X-rays in the evacuated tube is constant and not flickering, as in the old tubes, using ordinary coils or high frequency machines. Note the immense size of the apparatus. This new ray cannot be developed with smaller apparatus, it is stated. Various kinds of current, such as Tesla, high tension, static, Oudin, etc., can be produced by this machine just by changing the switches, shown on the front of the apparatus.



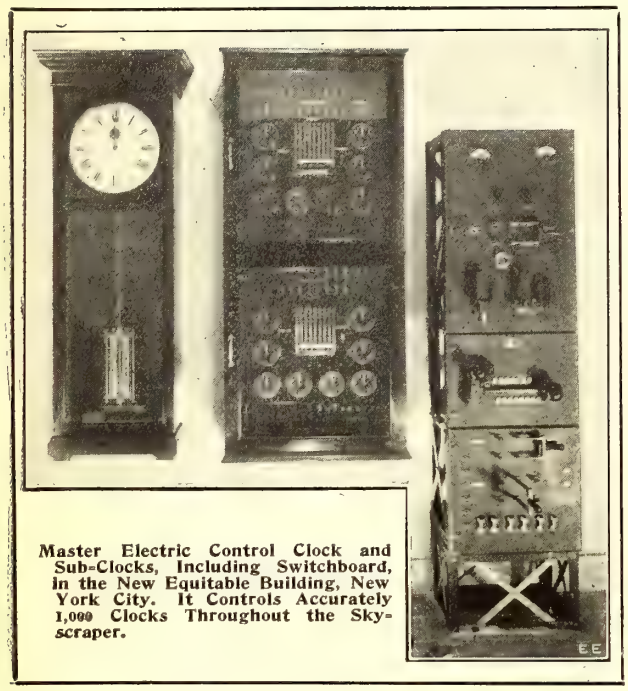
(C) By Janet M. Cummings.

Marvelous New X-Ray Machine Capable of Producing Sparks 39 Feet in Length. Its Inventor, Charles H. Stanley, is Shown in the Picture.

So powerful is this ray that X-ray pictures can be readily taken 35 feet from the tube and strong effects are also produced on a fluoroscope. It has also a great healing effect on cancer, tumors and similar diseases which the ordinary X-ray has not, or at most to a very small extent. Therefore, this new invention may prove a wonderful remedy for the now incurable diseases. It is called the "Stanley Ray," after its inventor.

NEW ELECTRIC CLOCK SYSTEMS OF THE EQUITABLE BUILDING.

The most difficult problem of to-day in modern office buildings is the regulation of the clock system. The photograph here presented shows the complete mechanism for controlling one thousand electric clocks in the new Equitable building, New York City.



Master Electric Control Clock and Sub-Clocks, Including Switchboard, in the New Equitable Building, New York City. It Controls Accurately 1,000 Clocks Throughout the Sky-scraper.

The master clock is shown at the left, which is connected to two sets of relays mounted on a panel shown in the center of the picture. These relays are connected electrically to 16 different lines in the building to which all the secondary clocks in the separate offices are connected. The 16 secondary controlling clocks herewith shown in the panel are connected in parallel with each line. This is done to indicate to the operator the condition of the line. If any one of them stops he can readily see which line is out of order and thereby save time in finding the trouble. Each line has a set of fuses, and also the master clock circuit is properly protected by circuit-breakers on the main panel seen at the right of the photo.

The current used for this system is supplied by a storage battery of 24 to 30 volts, controlled by a switchboard seen at the extreme right. An end cell switch is provided for regulating the battery voltage. The clocks are electrically wound and synchronized by means of a step by step magnetic method. This clock system represents one of the finest and most accurate ever installed in this country. Compare this masterpiece of an "automatic electric timekeeper" with her 1,000 wards to the accuracy attainable if the old-time clockman regulated each of the 1,000 clocks by hand. —Photo by courtesy of *Architecture and Building.*

INSTITUTE OF RADIO ENGINEERS MEETING.

At the last meeting of the Institute of Radio Engineers before closing for the summer holidays and held on June 9 at Columbia University, New York City, two excellent papers were read as follows:

"Engineering Precautions in Radio Installations," by Mr. Robert H. Marriott, B. Sc., and the second paper was entitled "Static Elimination—Some Suggested Methods," by Prof. Dr. Alfred Norton Goldsmith, of the College of the City of New York Radio Laboratory.

Both of these papers were well received and contained some new and vitally interesting points on radio matters.

Mr. Marriott's paper dealt at length with the proper installation of all wiring on shipboard for radio sets, such as grounding or iron pipes containing wires and the grounding of all auxiliary metal parts in some cases. It was recommended that all metal members on the vessel be grounded, especially when powder or highly combustible or inflammable materials were to be carried. He explained at length that practical tests had shown that sparks would be produced between various metal parts on the ship and other metal parts, which latter might be grounded, or even between two insulated metal parts. In some cases even the rails around the decks have become charged by induced radio currents, and therefore all metal fittings should be well grounded to the metallic hull of the ship.

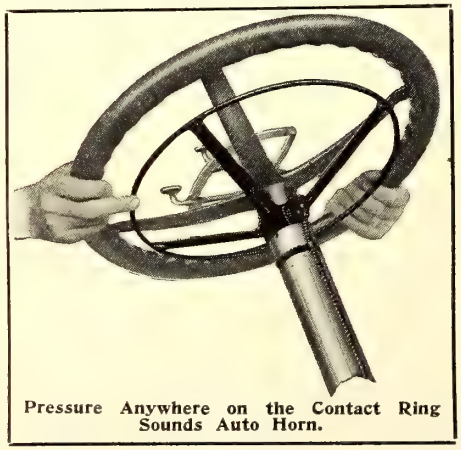
Prof. Goldsmith's discourse was rather hyper-scientific and quite difficult of practical demonstration or adaptation. It related to shielded aerial wires, etc.

Some interesting discussion was indulged in by those present, and Prof. Ferdinand Braun, of Germany, the famous radio authority, took an active part in same, as did also Mr. Weigant, designing engineer of the Marconi company.

IMPROVED SIGNAL-HORN SWITCH FOR AUTOS.

The new Seng switch recently developed for operating electric signal horns on automobiles, and shown in our illustration, possesses considerable merit, it seems, as no matter at what point of the steering wheel the hands grip same, it is always possible to operate the electric horn by just touching the "complete" contacting ring, which is shown mounted below the steering wheel proper.

German silver contacts are used in the make-up of this special switch and it should find a wide application among motor car owners and drivers of same.



Pressure Anywhere on the Contact Ring Sounds Auto Horn.

The switch is so made that it can be attached in a few moments' time to any steering wheel head, and it is provided with a length of flexible conductor with substantial insulated covering on same.

ELECTRIC HOUSE WIRING TROUBLES.

By W. F. Bennington.

PROPERLY installed electrical apparatus is the safest and healthiest means of providing heating and illumination. If improperly installed, however, it often becomes a source of extreme danger. The rules which govern the installation of electrical apparatus in this country are issued by the National Board of Fire Underwriters and are exceedingly rigid. To the average man they seem extreme. The matter of safety depends to a great extent on the honesty of the electrical contractor in properly installing the wiring and apparatus in accordance with rules of the above board. To receive the approval of the National Board of Fire Underwriters any electrical apparatus must pass a series of rigid tests before the approval is granted to the manufacturer. Wire is put through an exceptionally rigid test for insulating properties. Although the use of "approved" apparatus and wire may help to prevent trouble, the greatest source of danger lies with the electrical contractor and the help that he employs. A carelessly installed wiring system will sooner or later cause trouble and necessitate endless repairs and annoyance.

Perhaps the greatest source of trouble is *loose connections,* which cause heating and eventually the destruction of the connection itself. The heat from a loose connection will start any woodwork smouldering that is in contact with it. As a general rule these connections are out of sight and the trouble may continue for weeks without giving any warning. Suddenly there is one of those fires that seem to start from nowhere and are due to the fact that some careless workman neglected to tighten a screw or left a joint poorly soldered. Very often, however, a loose connection will give evidence of its existence by the flickering of the lights. This should have immediate attention, as it is sure to mean that something is the matter. As a general rule people blame the lighting company and talk about "inefficient service." Sometimes this is the cause, but don't take chances—find out. Turn on all the lights in the room and see if they flicker. If they do turn on all in the house and see if they are affected in the same way. If you find that one room alone is affected go to the distribution box and see if the fuses that control that room or part of the house are loose and tighten them up if necessary.

Loose fuses are often the cause of flickering lights. Should you find that all lights in the house are flickering and that the connections to the service are all tight, then call up the lighting company and tell them about it. If the trouble seems to affect only one room or part of the house and you cannot locate any loose connections or fuses, call in an experienced electrician and your troubles will soon be past. Make yourself familiar with your lighting system and know just where the fuses for each part of the house are situated and also keep a supply of spare fuses handy. This will save you a large amount of trouble and inconvenience, as it is unnecessary to call in an electrician every time there is a fuse blown. A few moments' explanation by a man familiar with house wiring and you can install your own fuses.

Don't overfuse your circuits. If a circuit is intended to carry a current of 10 amperes, don't put 30-ampere fuses in. The fuse is similar to the safety valve on a steam boiler, and putting 30-ampere fuses where 10-ampere should be is exactly the same as setting the safety valve of a boiler at three times the pressure that the boiler will safely carry. By putting in fuses of a

higher capacity than the circuit is wired for you stand an excellent chance of causing trouble that will be expensive to repair.

We come now to one of the most common troubles and one that is little understood by those not familiar with electricity. A copper wire will carry only a limited amount of current with safety. Should you exceed this amount the wire will begin to warm up, and the more current you cause it to carry the greater the rise in temperature, until finally it will come to the melting point and "blow out." Overloaded wires are the cause of many fires that "cannot be accounted for." The permissible amount of current for a wire of any size is determined by the regulations of the National Board of Fire Underwriters and should never be exceeded without special permission. This is a subject for the electrician to determine. The capacity of your wiring should be sufficient to carry all that you would be likely to use and also to allow for any future additions that you might wish to add. The trouble comes when Mrs. Smith or Mrs. Jones buys some of the modern electric heating devices, such as flat irons, toasters, percolators, etc., brings them home and screws them on the socket. If the circuit is fused just enough to carry the lighting circuit of that room the addition of the new device will blow out the fuse if the current it takes is in excess of the fuse capacity. Perhaps the fuse capacity is too large, and then she may add one thing after another until the wires are carrying more than they can stand and then they will "blow open" or overheat and cause a fire. The best way is not to take chances, but when you wish to install some of the new heating devices call up the electric company and have them look the circuit over.

And now a few words regarding "shocks." The average lighting circuit is about 110 volts, and one might almost say harmless as far as injury from a shock is concerned. All apparatus made to-day for home use is carefully insulated and the danger of receiving a shock slight, but this does not mean that little Willie can take a screwdriver and try to dissect the anatomy of your table lamp. He will not be injured by the shock, but it is almost certain that he will give himself a nice burn and in all probability spoil the lamp, if not the fittings to which it is attached. This applies not only to lamps and sockets, but to electrical apparatus in general.

My advice to any man who does not understand his lighting system is to let it alone. Your effort to avoid a bill from the electrician may result in burned fingers and spoiled apparatus. Call the man who knows just what he is doing, and the chances are that the trouble is small if your house has been properly wired. Let it alone—it pays.

Porcelain sockets should be used in any place where there is a chance of moisture, or where people are likely to get into contact with the ground. The "ground" means water or steam pipes or any metal that is connected to the earth. Bathrooms and cellars are places where porcelain sockets should be used—the bathroom especially, as there people often stand in their bare feet, with wet hands, and water is an excellent conductor. Death has been known to result from turning on an electric light while in the bath, though deaths from the average lighting circuit are very rare indeed.

Familiarize yourself with your lighting circuit, observe the above suggestions and you are sure to save time, trouble and expense. There is no mystery about house wiring or apparatus. Spend an hour or so with your electrician, let him explain to you how it works and you will find it an excellent investment. Remember! Safety first.

ELECTRIC CHART TELLS PERCENTAGE OF DEATHS IN NEW YORK CITY.

It is pointed out that of every hundred children born in New York City 11 die within a year, in a recent number of the *Edison Monthly* magazine, and only one attains the age of 90. The city no longer produces centenarians.

A short time ago the Department of Health conducted a statistical study of the ages of the persons dying in New York. This detailed study covered a period of 13 years and involved 225,000 deaths, the figures here quoted being based on this record.

In the illustration is seen the novel method employed to graphically show the rise and decline of the population in the city. This electrical lamp-board is exhibited at the department's museum on Centre street, in the metropolis. In all, there are 100 incandescent electric lamps mounted on the lamp-board, in rows of 10. A specially arranged automatic flasher lights all of the lamps first; then at intervals of several seconds the flasher extinguishes the lights, until the chart, in a very striking manner, shows that all have died before reaching the age of 94.

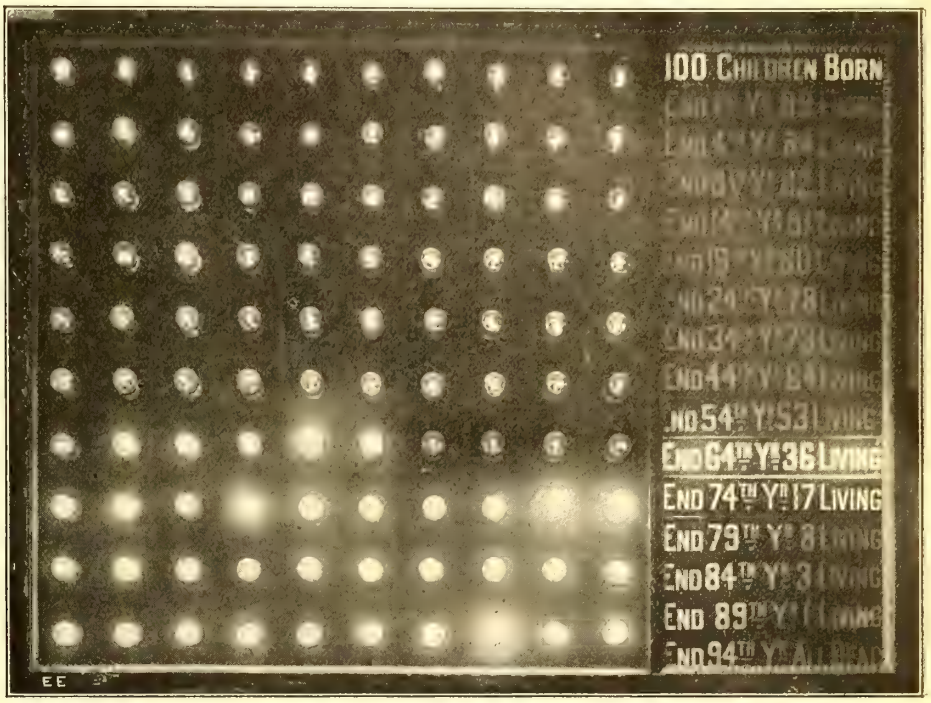


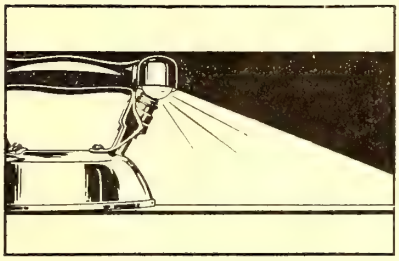
Photo Courtesy of New York Edison Co.

Electric Lamp Chart Depicts in Graphic Manner Mortality of a Great City.

This idea can very well be applied to many other branches of city departments, or also in many industrial corporation offices where records are to be studied by a number of interested people simultaneously. Besides, this method has a very striking effect, not made posible by any other means of indication.

ELECTRIC IRON CARRIES HEADLIGHT.

An electric iron with a feature that is entirely new has recently been developed by a Pittsburgh concern. This feature is a small *Mazda* lamp attached to the iron in front of the handle. On account of the presence of this lamp, the iron has been named the "Hedlite Iron." Due to the fact that the lamp is only a few inches above the surface to be lighted, it gives more light upon the ironing board than would be obtained from several large lamps located in a ceiling fixture.



Electric Sad-Iron Carries a Head Light.

The lamp is provided with a metal reflector, which has a shield to keep the light from striking the eyes of the operator, both when ironing and when the iron is at rest in a vertical position. The lamp socket is supported by the front handle bracket and the supply wires from the lamp are carried through a metal tube to the interior of the iron.

The lamp burns whenever the current flows through the iron and thus acts as a warning signal if the current has been left on by mistake. The current consumption of the lamp and iron is 500 watts. The iron is made in both tilting and stand types. The lamp is especially desirable and efficacious where there is only one outlet, as is frequently the case in apartments and small dwellings.

LIGHTNING RODS REDUCE PROPERTY DAMAGE.

In the annual report of W. E. Longley, State Fire Marshal of Indiana, attention is called to the fact that, as a result of the increasing use of lightning rods on farm buildings, only 453 cases of lightning damage were reported in Indiana during 1914, compared with 1,006 during the preceding year. "Lightning rods properly placed afford certain protection," declares the fire marshal, "for only seven buildings equipped with rods were struck during 1914. In these seven instances investigation showed that the rods either had gone a long time without proper attention or were not properly grounded."

Some Famous Electrical Laboratories.

PROBABLY there is no electrical concern who maintain a finer or greater variety of testing and research laboratories of every description than those of the General Electric Co., whose main plant is at Schenectady, N. Y., and who also maintain extensive plants at East Lynn, Mass., and several other cities.

The views shown herewith are those taken of some of the principal laboratories of this company at Schenectady. The portrait in the center of the group is a likeness of Dr. Charles P. Steinmetz, chief engineer of the General Electric Co.

eventually reach some satisfactory solution of their multifarious problems, thanks to the brilliant staff of specialists they maintain, and also to the extremely fine laboratory facilities afforded.

In Fig. 1 of the illustrations here presented is seen a section of the chemical laboratory, where all kinds of acids, salts, rare metals and oxides, etc., are kept ready for any kind of research work encountered. In the illustration at Fig. 2 is seen a corner of the special research laboratory, where various kinds of new lamps, vacuum bulbs, etc., are electrically tested out. A desk fan a million cycles per second or more.

Another view of one of the chemical laboratories is shown at Fig. 4, and here is observed also a set of electric ovens used for heating and other purposes. These electric ovens have rheostats located on the bench beneath them, so that the heat may be very finely regulated to any required temperature desired by the chemists.

Every modern appliance is at hand in these wonderful laboratories and they are probably the best equipped in the country to-day, if not in the world. No problem is given up until all of the research staff have



Several Views of the Wonderful Research Laboratories Maintained by the General Electric Co., at Schenectady. Center: Chief Engineer Dr. Charles P. Steinmetz.

This renowned engineer and scientist has associated with him some of the leading scientists and research workers of this country, and in this brilliant array appear the names of Irving Langmuir, Sol Dushman, Coolidge, and many others of whom perhaps we have not heard much in a popular way, but who are hard at work solving the many problems confronting such a vast corporation as this. Every imaginable kind of research work is done in these laboratories, including the fields of physics, mechanics, optics, all branches of electrical science, X-ray and incandescent lamps, chemistry, etc., ad infinitum. This will be the more impressed upon the reader's mind when it is said that the General Electric Co. never attempts to do a thing half way, but always goes to the bottom of any problem tackled. Also they, in most every case, may be observed mounted on a portable stool and blowing a draught of air on a special electric tube, noticeable just to the left of the "danger sign." A second tube of this type is also shown, illuminated, toward the left of the picture.

In Fig. 3 is depicted a section of the high voltage testing laboratory. Here extra high voltage insulators and insulating materials, etc., are tested for break-down strain or electrical resisting strength. Great care must be observed by those working in these high voltage laboratories and danger signs are kept posted, marked with proper warnings. X-ray tubes are tested out in this laboratory also. High voltage alternating and direct current is available for this class of work, and practically any voltage desired for tests here conducted is available at any frequency desired from 60 cycles up to half

had a try at it, and many marvelous inventions have been developed in these always busy "think factories."

TO LIGHT NIAGARA WITH SAN FRANCISCO EXPOSITION SCINTILLATORS.

A movement has been organized in the sister cities of Niagara Falls, N. Y., and Niagara Falls, Ont., to acquire the battery of electric searchlamps now being used for the scintillator illumination at the Panama-Pacific Exposition at San Francisco, and to provide for the electrical illumination of the Falls during a number of months of each year.

Are you a subscriber? Better decide now so you will not miss the many good things in the forthcoming September issue, 64 pp.

How Telephone Transmitters and Receivers Are Made

Do you know of the vast research work back of the telephone instrument you use daily? Telephony has grown to be one of the most highly specialized of applied sciences. How the separate parts of every instrument are exhaustively tested is explained in this article.

LITTLE does the average person, using the modest-looking telephone of to-day in its neat black dress, dream of the stupendous amount of money and engineering end of the game. We shall in this brief discourse endeavor to look into some of the more interesting aspects of the making of the telephone instruments. The

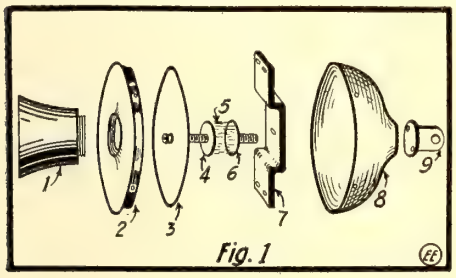


Fig. 1. Parts Making Up the Telephone Transmitter.

wonderful history of its inception and perfection have been well cared for in the extensive literature of the day and we will not take up the reader's time with such matters here, as space does not permit. Those interested would indeed do well to read Herbert N. Casson's wonderfully interesting treatise, "The Romance of the Telephone."

The Transmitter.

There are, of course, many different styles of telephones on the market, but as all are made up of essential parts, known as the *microphone,* into which we talk, and the *receiver,* which reproduces our speech, with more or less auxiliary attachments, we shall consider the most important parts, viz., the microphone and the receiver.

The "Bell" instruments used in this country are manufactured by the Western Electric Co., and as these have been simplified and standardized to a remarkable degree the greater part of the work here mentioned is that performed on "Bell" type sets.

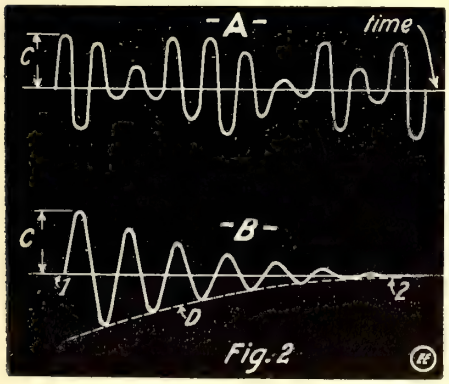


Fig. 2. At A, the Varying Voice Waves. At B, the Decay of Diafram Vibrations From Maximum Amplitude to Zero.

Take first the modern microphone, which picks up our spoken voice air waves and transforms them into undulating electrical currents, which are carried over the line to be retransformed into air or speech waves at the distant receiver. Its principal parts are observed in Fig. 1. The spoken voice sets up air waves which are projected into the mouthpiece and against a thin iron diaphragm 3, supported tightly all around its rubber-bound edge in the brass plate 2. The diaphragm 3 has secured at its center a small screw and nut, the inner end of the screw or stud carrying a polished carbon disc 4. A similar disc, carried by a metal bridge bar 7, forms the microphone chamber 5, which contains a small quantity of carbon grains. The transmitter parts being quite delicate, of course are contained in a strong punched-brass shell 8. A swivel or trunnion lug 9 is secured to the base of the shell, thus allowing it to swivel up or down in the manner we all know.

This will give a clear conception of the most important parts of the microphone, or transmitter, as it is termed. Each of the parts outlined and making up the complete instrument is the final result of vast technical research in the storehouse of Dame Nature.

The mouthpiece No. 1, for instance, although it looks very simple, has a history of its own. In the first telephone the mouthpiece was simply a hollowed-out portion on the wood front of the cabinet. Later a wooden funnel was introduced. This progressed through various stages of fibrous and hard-rubber composition, and some of the latest tried out were of glass and porcelain. Glass is very sanitary, but extremely fragile. Porcelain is still going through the test stage. "Condensite" is one of the newer synthetic compositions being tried out for the mouthpiece and possesses many good qualities, notably strength. It may be dropped on the floor without breaking. The mouthpiece is an important part indeed, and its shape and "sound" qualities are always going through research tests to find something better. That, in truth, may be taken as the slogan of the telephone specialist: "Something better." The search is everlasting and constant.

Consider the front plate of the case, or part No. 2. For many years this was composed invariably of a cast-brass or alloy plate. Now it was found, by observation and exhaustive trials, that it was practically impossible to produce a cast plate for this purpose which could be polished and nickel-plated, that would show up absolutely smooth and free from blemishes due to air or "blow-holes" in the casting.

Hence a staff of technicians were started to work on this problem, with the result that the plate is now made of a special bronze or brass alloy, made to a specified chemical formula and rolled in sheet form. The discs are blanked out in massive punch presses, electrically operated, and after passing through several punching and bending stages, we have the finished part ready for nickel-plating. Only a certain alloy will permit of the many and intricate bending and forming operations necessary to give it the proper shape. Sometimes a whole "lot" of sheeting cannot be used, owing to a slight difference in its chemical make-up, etc., causing it to crack while being punched and formed. Even the nickel-plate on the surface of it is scientifically investigated and the heaviest plating ever used is applied to give maximum "wear resistance."

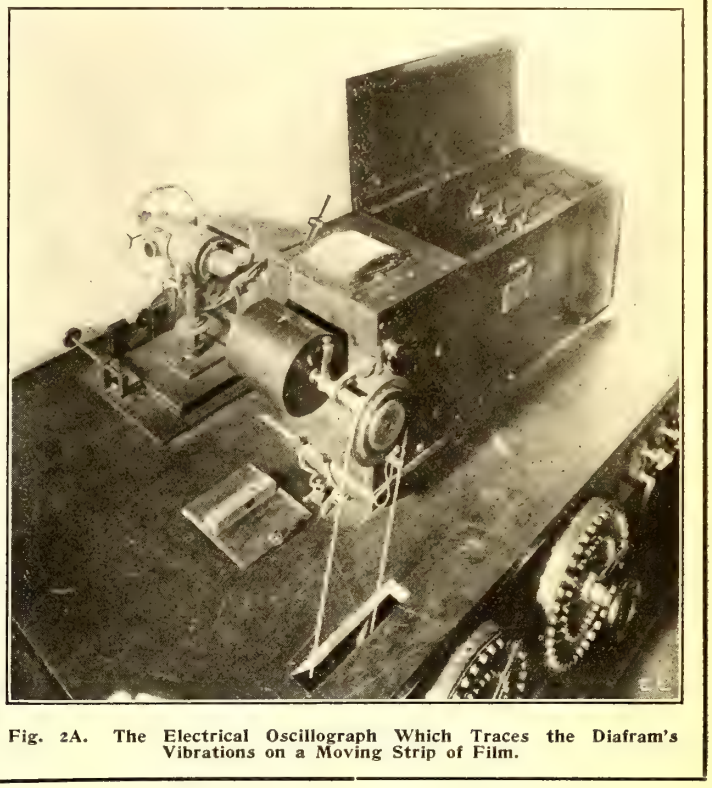


Fig. 2A. The Electrical Oscillograph Which Traces the Diafram's Vibrations on a Moving Strip of Film.

The diaphragm 3 is the part the average user of the telephone never sees, because it is hidden behind the plate 2 and perforated mouthpiece 1. This is one of the most closely studied parts in telephone science. Bell and Watson, in the early days, tried out all sizes and thicknesses of diaphragms, and the research in this direction has gone on ever since. The transmitter diaphragm need not be magnetic in character, and many different materials have been exhaustively experimented with, such as mica, gold-beaters' skin, fiber, brass, etc.

The present "Bell" diaphragm is made of a certain quality sheet iron, the thick-

ness being specified in thousandths of an inch, as well as its chemical constitution. To prevent rusting, they are treated in various ways. Some of these methods consist of "Sherardizing," electro-deposits of zinc, coating with Japan enamel, etc.

This covers some of the physical sides of the problem. When the finished dia-

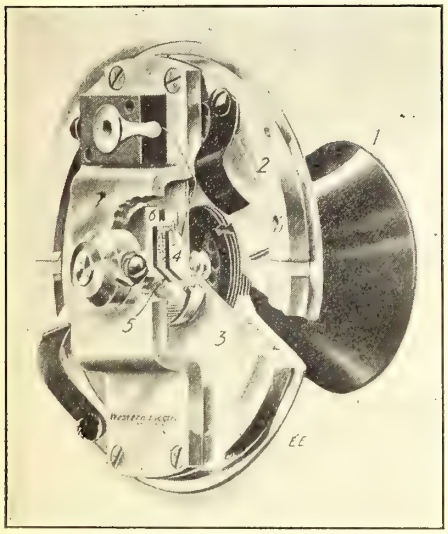


Fig. 3. Assembled View of Telephone Transmitter, Showing Carbon Grains, Etc.

phragm is ready for the electrical laboratory it undergoes a thorough and relentless test for various properties such as its elasticity and ability to follow faithfully the voice-wave undulations or vibrations. The voice waves are of many forms and frequencies and it is very important that a microphone diaphragm shall be able to pick up all the more important "speech-component" frequencies in the great numbers of complicated wave forms occurring in the average voice.

For the study of the diaphragm's vibrations an electrical oscillograph is utilized. This device records the vibration characteristics of the diaphragm when used for "speech" functions and also the time-period of its decay to a neutral or zero-vibration period after it has vibrated to maximum amplitude. Oscillograms of these vibrations are depicted at Fig. 2. The upper set of waves or ripples "A" are those of voice vibration, while the lower waves "B" show how the diaphragm's natural vibrations decrease from a state of maximum amplitude or vibration "C" at 1, to a zero vibration point at 2.

The balance of the microphone comprises, electrically, the carbon grains 5

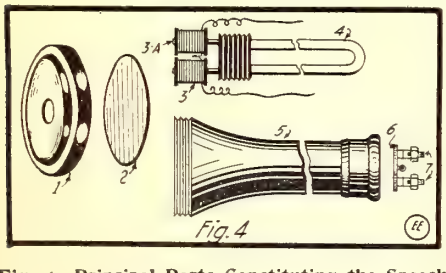


Fig. 4. Principal Parts Constituting the Speech Reproducer or Receiver.

(Fig. 1) and two carbon discs 4 and 6. The carbon used for this purpose is made in a special laboratory devoted to the purpose. Special furnaces are installed and all kinds of temperature and other measurements are taken while the grains and discs are being fired and annealed. The carbon mixture is the closest-grained product ever perfected and is susceptible of taking on a very high polish.

The grains are quite small, but regular in size and quality. The discs 4 and 6 are secured firmly to the brass sub-discs and supporting studs for attachment to the metal shell members. The carbon disc faces are polished like a mirror in specially designed rotary polishing machines driven by electric motors. Each machine will polish a great number of discs in a short time, owing to the unique arrangement of the machines. It may be remarked that mostly girls are employed in making up the parts, and especially in the assembly department.

The complete transmitter is illustrated at Fig. 3, and behind that innocent-looking little device is a battery of the foremost scientists in the electrical and mechanical realm, still banging away at the problem of "something better."

The Telephone Receiver.

The receiver on the telephone we use has, oddly enough, remained about the same as Alexander Graham Bell's original

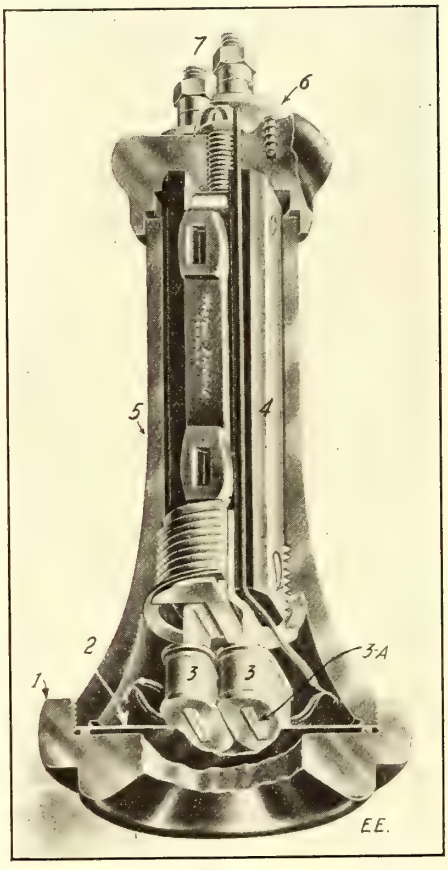


Fig. 5. Assembled (Sectional) View of Telephone Receiver. Standard Long-Distance "Bell" Style.

instrument—a remarkable tribute to the basic soundness of his theories and early instrument. If his original instrument had not been right to an almost infinite degree it would scarcely have lived through the first few years of its existence, which it did in the face of the most stupendous patent-suit litigation this country has probably ever witnessed. Inventors by the hundred sprang up, like mushrooms over night, claiming that they had prior patent rights on a speaking telephone similar or superior to Bell's patents. He finally won out in the highest court in the land, however, and the telephone got started on its way.

To proceed, the standard forms of the telephone receivers are the "Bell" commercial long type and the watch-case receiver, resembling a watch in size. The illustration (Fig. 4) shows the principal parts of the long receiver, and Fig. 5 shows the complete assembled receiver.

(To be concluded.)

OUR SUPPLEMENT

GUGLIELMO MARCONI, D.Sc., the subject of our supplement this month, is undoubtedly the acknowledged pioneer in wireless telegraphy, as we know it to-day. He it was who, by his persistent experiments and studies at the Leghorn Technical School in Italy, made possible signaling without wires over marvelous distances by means of electro-magnetic waves properly set up and propagated through the ether which, so far as we know, pervades and fills up all interstellar space, both inside and outside of our planet, the Earth.

Signor Marconi, of Italian parentage, was born at Bologna, in Italy, in the year 1874. He is therefore a comparatively young man and more zealous than ever in his endeavors to improve and perfect the art of wireless telegraphy and the apparatus pertaining thereto.

We probably are all familiar with the early history of wireless, dating from the time of Marconi's successful tests conducted at his father's estate at the Villa Griffone, near Bologna, which tests and experiments were conducted in June, 1895. Shortly thereafter it became possible for him to cause a receiving instrument to be actuated by wireless waves over distances of one and one-half miles, using poles to support large tin sheets connected with wires, and which poles were but 25 feet in height.

These early experiments were carried on principally with a small spark coil provided with ball spark gap, and for the receptor a Branly metal filings coherer was used. Marconi improved this coherer wonderfully, so as to make it reliable and sensitive to the very minute Hertzian wave currents propagated through the ether from the spark at his transmitting station.

Shortly after the successful tests in Italy, or in July, 1896, to be exact, he went to England and there introduced his remarkable invention to Sir William Preece. Marconi had already applied for a British patent during the preceding June and Preece was very favorably struck with the Italian's invention. By 1897 it was possible to transmit and receive wireless signals and messages by these methods over distances of nine miles between Penarth and Brean Down, across the Bristol Channel. On the Salisbury plain he covered distances of four miles and more overland, employing in these tests a 6-inch spark coil for distances up to four miles, but a 20-inch spark coil was used at different times in tests conducted over greater distances. Also large kites were employed from time to time to elevate a fine aerial conductor, and good results were obtained with this method. Some of the first transatlantic wireless signals in the form of that immortal letter "S," comprising three dots in the Morse code, were received by the aid of kites flying at a high altitude.

In the first few years of wireless many installations were made on various ships of the English and Italian navies, etc., and one of the first important applications made of the new Marconi wireless system was to establish communication between the King of England's yacht and a shore station.

To-day the Marconi system is the largest and most comprehensive extant, and distances of 3,000 to 4,000 miles have been covered repeatedly.

The world owes a debt to Dr. Marconi which cannot be overestimated, and his name is sure to ring down through the ages as the real inventor of practical, commercial wireless transmission of intelligence.

An Interview With Guglielmo Marconi

By Samuel Cohen

WHAT a wealth of meaning there is to the two words, "Marconi" and "wireless" to practically every educated person to-day! Undoubtedly for many years to come the name of Commendatore Guglielmo Marconi will be famous throughout the world and known in practically every household as that of one of the greatest benefactors of the age and as the pioneer inventor and perfecter of wireless telegraphy, as we know it to-day.

Dr. Marconi is well past middle age and looks in the best of health. He is rather tall and well set up, marking him, you perceive, a military man in more aspects than one. This is due, in a great measure, to the fact that he is a Lieutenant in the Italian Navy. He bears his 41 years well, indicating an uncommonly strong mind and body.

As the wireless telephone is one of the latest and most misunderstood apparatus, perhaps, of the present time, I asked him how this matter was progressing. Mr. Marconi stated that there was great hope for the future and, in fact, in the very near future, of greatly extending the range of wireless telephony. "It is being used on practically all warships of the Italian Navy," he stated, "and is being employed to a considerable extent in the British and other navies. Apparatus of the Arc and other types are being used and thoroughly tried out for this purpose, and the best grade sets, such as used in the Italian Navy, can transmit the spoken voice over distances up to 100 miles and more, which is very good, of course, considering that on shipboard it is difficult to erect a very large antenna. One of the later developments in wireless telephone apparatus is that making use of a modification of the well-known *Fleming Valve*. By suitably combining an oscillatory circuit around this valve and also by means of other super-imposing circuits containing the microphones, we have made it possible to talk over quite considerable distances by this very simple and sure means. It is more stable and certain in its character by far than the Arc type of apparatus, generally speaking."

"These wireless telephone sets are provided with a simple switch by which the operator can change over from transmitting to receiving speech very quickly, and they are operated by means of an 80 ampere-hour storage battery which heats the vacuum valve filaments and also a 500 volt current is provided for actuating the trigger control circuit of the valve, as it is called."

"This current is produced by dry batteries, and these sets are not limited to the transmission of wireless telephone speech, but can very easily be converted into wireless telegraph transmitting sets by the substitution of a Morse key in the circuit, etc. These vacuum tube transmitters are able to work over ranges up to about 35 miles thus far."

I asked Dr. Marconi about the other forms of wireless telephone apparatus or undamped wave type generators, etc. He intimated that a great deal of experimental and research work was being carried out in England and in some of the other Marconi laboratories on the multiple spark frequency wireless generator which can produce practically undamped waves by allowing several different sparks in the circuit to jump the gaps at slightly different periods. In this way there are not any long breaks between the sparks and the ordinary dead-time period between sparks of the common radio transmitter, are filled up with the waves from other sparks synchronously and critically timed.

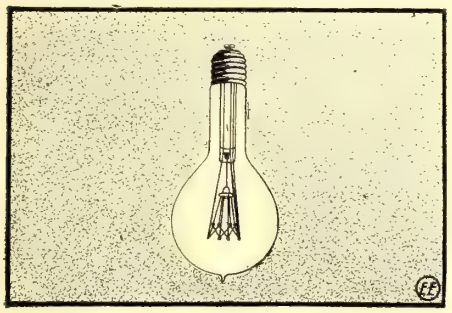
One of the latest branches of science Dr. Marconi is intensely interested in is that of seeing over a wire by electricity. He mentioned that a considerable amount of research work has been done in transmitting images by wireless and successful results were already obtained. Dr. Marconi is quite sure that the time will soon come when one will be able to see a friend in Europe by means of wireless television and at the same time speak to him.

Regarding the powerful and recently completed trans-Atlantic radio stations in England and the United States Dr. Marconi is hopeful the European war will soon cease so that these stations can be put into regular operation. These are at present tied up for the reason stated and particularly as the British Government has taken over the control of the Wales stations for official work of the War Department.

Before departing I suggested to Dr. Marconi that thousands of young experimenters in this country would highly welcome a picture of himself to adorn their dens and laboratories. Dr. Marconi then graciously autographed a photograph for the especial benefit of the readers of *The Electrical Experimenter*. It is this photograph which forms a supplement to this number.

NEW DOUBLE-FILAMENT GAS-FILLED LAMP.

A "two-in-one" incandescent lamp, as it is called, has recently been put on the market and it should find a wide sale. The filament is made in two sections, one of which can be operated while the other is out of service, or both may be burned at the same time. Thus, if the lamp is rated at 200 watts, each side takes 100 watts. Either or both sections are placed in circuit



Latest Double Filament Gas-Filled Incandescent Lamp.

by a screw attachment in the base. The lamp is filled with nitrogen, argon and other gases. The specific consumption, the manufacturer asserts, is 0.6 watt per C.P. or less. The average life with the filament sections burning separately is 2,000 hours, and with both burning together 1,000 hours.

ELECTRIC SMOKE RECORDER.

By Frank C. Perkins.

The accompanying illustration shows a novel and interesting smoke recorder, electric motor driven, as recently developed at Chicago, Ill. It is held that war was declared against the smoke nuisance in the reign of Queen Elizabeth and has been going on ever since.

The problem therefore is to find the means of making the careless and negligent fireman careful. It is in the nature of every man to be more attentive to business when he is under inspection.

Recording apparatus of every kind is coming more and more into use, particularly in power plants. It is maintained that the most effective remedy for the smoke nusiance that has ever been produced is the smoke recorder. It proves itself if one admits that careless firing is the one great cause of smoke, because the smoke recorder is a check, both upon the chimney and the fireman. Smoke can always be greatly reduced and sometimes completely eliminated by careful management of the fires. No matter what kind of "smokeless furnace" one may have, it cannot live up to its title and make steam unless it is managed with care and intelligence.

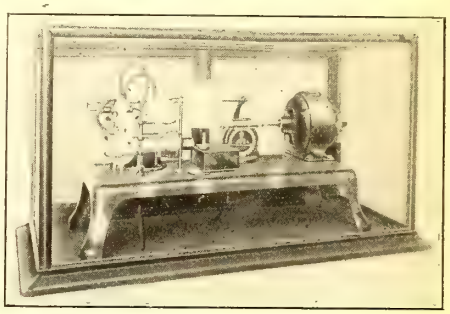
This new electric-driven smoke recorder originated in the brain of Ray L. Eddy, who has devoted many years to the study of smoke, its causes, effects and remedies.

This electric recorder is the "watchman" that informs the fireman immediately if the stack begins smoking. He can at once adjust the dampers or apply any other remedy that is recommended by this observation and experience. He can stop smoke within the time limit named by the city ordinances, and in all probability before a smoke inspector or some complaining citizen can get his eyes upon the chimney.

In order to fight smoke it is necessary to know what causes it. Smoke is usually caused by lack of air, improper mixture of the air with the gases or lack of temperature. Improper furnace design often has much to do with it.

The electric smoke recorder is built like a watch and, entering into the theory of the principles involved in the smoke recorder, it may be stated that if one drives a jet of smoke against porous paper the soot and other coloring matter will adhere to the paper and form a permanent record. It will be permanent because the soot particles will be driven into the pores of the paper. The record upon the paper will correspond with the color of the smoke, irrespective of what that color may be.

There are two things necessary in the



Electrically Operated Smoke Recorder.

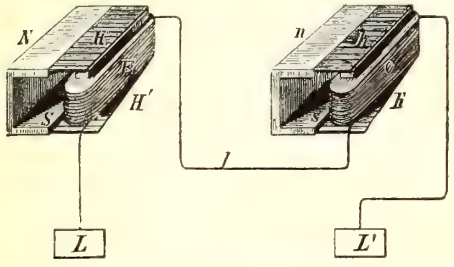
construction of a smoke recording apparatus. To provide means to draw a sample of the gas from the stack and force it through a small orifice and also to provide a sheet of the proper paper and a clock or other mechanism to move it. Reduced to its primary elements, a smoke recorder consists of a pump and a clock and a piece of paper.

It may be stated that the chart is sectionally ruled in hours and minutes, each chart covering a period in excess of 12 hours, and one can tell almost to the second when the chimney began to smoke and also when the fireman stopped it by proper firing.

THE BIRTH OF THE TELEPHONE.

An extremely interesting lecture on the birth and babyhood of the telephone was presented by Bell's former co-worker, Thomas A. Watson, before the New York Electrical Society at a recent meeting.

He detailed in an interesting manner how the telephone had sprung from the musical telegraph, upon which he and Prof. Bell were engaged. Although Bell had the idea in his mind for two years, it was not until June, 1875, that a successful speech-producing instrument was made. The first idea on the propagation of music or speech over a wire by electrical means was presented by accident. One of the musical telegraph reeds had stuck fast, and Mr. Watson said he plucked the reed several times. Prof. Bell at once came into the test room, demanding to know what Mr.



The Forerunner of the Telephone. Bell's Early Musical Telegraph.

Watson had done. Bell had heard the feeble undulatory magnetic impulses produced by the vibrating reed before its magnet and reproduced electrically over the short line in the musical receiver. Thus the germ was sown which laid the basis of the wonderful telephone system we have to-day.

The illustration here shown is of one of these early Bell musical telegraph systems, where a series of different-toned steel reeds currents in the coil E, which will pass through the wires l and ground L L' to the receiving coil H', mounted on a magnet also provided with tuned steel reeds in front of the coil. Thus a certain reed vibrating at the transmitter would set the "same tone reed" vibrating at the receiver. Multiplex telegraphy over one wire was the goal.

A replica of the first telephone used by Bell was shown and, of great interest also, the original wire used in the first half-mile telephone circuit ever erected by Mr. Watson in Boston. The wire was coiled on a small spool and preserved in a neat glass cabinet.

The first ringer for telephones was developed by Mr. Watson. For the first telephone installations the party was called by thumping the home diaphragm sharply with a pencil. This set up sharp sounds at the receiver end of the line and anyone near the instrument would hear the thumps, so to speak. Shortly after he invented the "Watson jingler," or polarized bell, operated by a magneto, and this device, like Bell's wonderful receiver, has practically remained the same in its design these 38 years past.

RUSSIAN DUMA GREETS ENGLISH COMMONS BY WIRELESS.

A new and powerful wireless station erected in Russia since the outbreak of the war transmitted the first messages to England recently in the form of a greeting from the Chairman of the Duma to the Right Honorable James W. Lowther, Speaker of the House of Commons. Mr. Lowther acknowledged the greeting by wireless.

TAPPING THE EARTH'S ELECTRICITY.

The latest suggestion of theoretic science is that inventive mankind will some day be able to tap the earth's electric supply. Everyone knows nowadays that the earth is, among other things, an enormous electric magnet and that as it twirls around eternally on its unseen axis its friction against the atmosphere creates a perfectly unlimited supply of electricity.

The British Royal Society claims that invention is already close on the track of perfecting a method by which this electricity can be collected from the atmosphere. If this can be done there will be no necessity for electric power plants.

Every factory will be equipped with an inexpensive machine that can absorb from the air electricity just as already there are machines that can absorb oxygen from water that costs little or nothing to collect.

The idea suggested is that some machine be created to suck down the earth's electric fluid. This is being done all the time by every tree, and it is this attractive force of tall trees that causes them to be so frequently struck by lightning during big thunder storms when the atmospheric electricity is present in enormous quantities.

A machine for collecting atmospheric electricity, however, would not depend on electric storms for its sources of supply. The atmosphere is always filled with a silent, all-pervading but powerful electric current. It is this permanent current that it is suggested mankind will some day succeed in harnessing to the triumphant car of human progress. When it is done, the race will have easier and quicker traveling toward the final triumph of mind over matter.

MARCONI A VOLUNTEER.

William Marconi has asked that he be enrolled as lieutenant of engineers and assigned to duty with the telegraph brigade at Florence.

A NEW 3-VOLT DRY CELL.

Ordinary dry cells used for bell and ignition work give but 1½ volts each. All such cells are the same as regards voltage. Now we have the "Nitrogen" 3-volt dry battery, which should find a host of friends. It is exactly the same size as the standard No. 6 Columbia cell and can be interchanged in battery boxes, etc. It is composed of two cells placed end to end, thus producing 3 volts. Owing to a new substance used in making up these cells their efficiency is much greater than that of ordinary dry cells. The experimenter will find this 3-volt cell a great convenience indeed for operating small motors, spark coils, lighting lamps, etc. It costs but little more than the ordinary 1½-volt cell and marks a new epoch in dry cell manufacture.



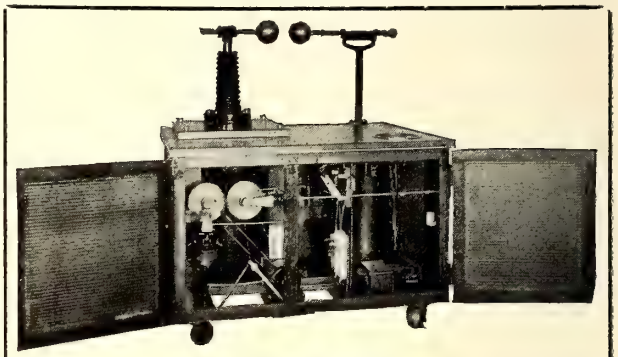
TO GO THROUGH PANAMA CANAL SHIP NEEDS WIRELESS.

It is now unlawful for any passenger steamer, whether of American or foreign register, carrying 50 or more persons, including both passengers and crew, to leave the Canal Zone unless equipped with wireless telegraph apparatus capable of transmitting messages at least 100 miles and having a competent operator.

NEW HIGH-FREQUENCY MACHINE FOR TESTING INSULATORS.

It has long been known that when a lightning bolt or discharge strikes a transmission line carrying electric currents this high-frequency atmospheric current will affect the insulators on the line in a different manner than the ordinary current, no matter whether it is direct or alternating current at any commercial frequency, such as 60 cycles, etc.

Heretofore high-voltage insulators, such as used on the wonderful long-distance transmission lines such as those in the Western parts of the United States and Canada, have always been tested at 60 cycles frequency for several times the voltage to which they were to be subjected in their regular duty on the line.



125,000 Volt High Frequency Oscillator.

It was found, however, that very frequently these insulators would fail for some apparently unknown reason, and after much inspection and research work it was found that a lightning discharge, in view of the fact that it is of very high frequency and similar to a wireless discharge, would strike right through the insulator and put it out of commission for further service. This happened many times where it was self-evident that the transmission line voltage could not have done any such damage.

One of the latest machines for testing these insulators under such lightning discharge conditions is shown in the illustration, and it is built by the General Electric Co.

It is designed and furnished, when desired, for use on any commercial frequency circuit, and utilizes about 2½ K.V.A. at 60 cycles on 110-volt A. C. circuit. It can produce very high frequency currents, running in value as high as 300,000 cycles per second at a potential up to 165,000 volts. Special forms of this machine are furnished, when necessary, giving as high as 500,000 volts. Hence the advance of the engineer continues in his decision to hold his own with the forces of nature.

ELECTRIC POCKET LAMPS FOR THE ARTILLERY.

Among the goods recently bought in the United States for use abroad by soldiers in the fighting zones were 5,000,000 electric pocket lamps. The demand for these lamps is due to the fact that on land the war has in large part become a long-range artillery duel, the other branches of the service meanwhile seeking protection from bursting shrapnel by living in covered trenches. In these trenches, as well as in the air, on the sea, or under it, electric pocket lamps are ideal illuminants.

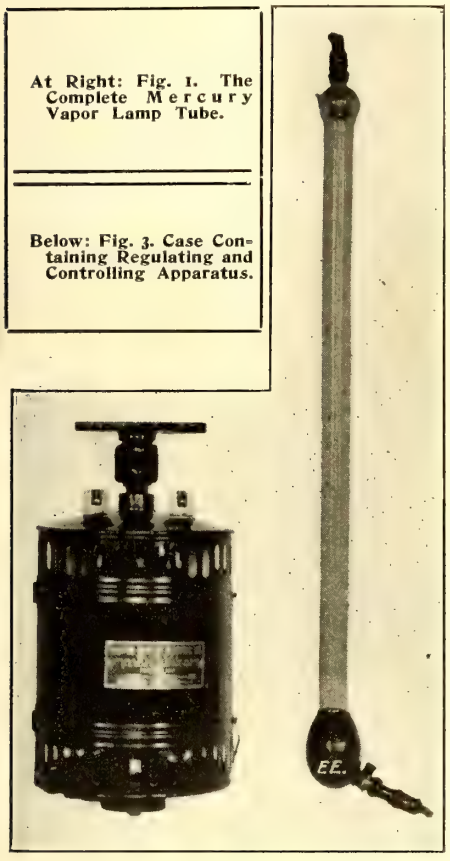
A Trip Through the Cooper-Hewitt Electric Works

By Theodore Hinchcliff

A trip through the Cooper Hewitt Electric Works brought to light two very interesting facts: First and most important, the advanced manufacturing processes involved in making the wonderful Cooper-Hewitt mercury vapor lamp, which is well known to our readers for its pleasant and efficient light, and second, its value in commercial applications. A. D. Child, of their sales staff, kindly conducted me through the various departments of the plant.

At Right: Fig. 1. The Complete Mercury Vapor Lamp Tube.

Below: Fig. 3. Case Containing Regulating and Controlling Apparatus.



The first step in the manufacture of the mercury tube (see Fig. 1) is the bulb, the tube comprising three glass pieces, A, B and C (Fig. 2), which are fused together. A small stem E is made on top of the large bulb B by heating that portion and blowing it out to the proper size. Another small glass tube E_1 is fused onto the tube E. This tube is used to connect the bulb B with the air-exhausting apparatus and for filling the tube with mercury.

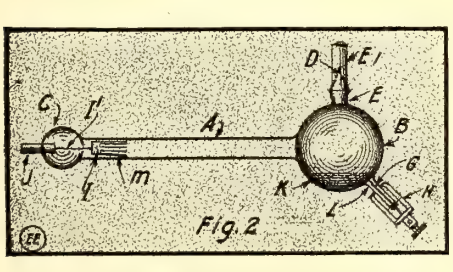


Fig. 2. Details of Mercury Vapor Tube.

The electrode G is now made and sealed in, which consists of a platinum wire sealed into the glass stem L, and is fastened to the connector H. The other electrode I is next sealed in. This electrode I consists of a cylinder of sheet iron with a small lap M for making contact with the mercury when the tube is tilted. The cylinder is joined to a small strip of platinum wire I^1, which is sealed into the bulb C and then connected with another terminal connector J.

After all these parts are made and skilfully placed in the tube the filling with metallic mercury K and exhaustion of the tube next takes place. The tube is brought to the mercury-filling department, where thousands of them are filled daily. The tube is connected by means of a rubber tube with the mercury chamber through the neck E, and a certain quantity of mercury is admitted, depending upon the size of the tube. Some tubes take six ounces, others 10 and 12 ounces. The tube being filled, it is now ready to be exhausted, and extreme care is taken in this process, as the *quality* of the tube depends entirely upon the exhausting. The tube is placed in a hot bath of air and connected with an exhaust pump, which is an ordinary mechanical exhaust pump. The connection is made through pipe E^1. While in the hot bath the mercury is boiled, thereby purifying it and also helping to drive out the air in the bulb. As soon as the operator sees that the exhaustion is complete he carefully seals the tube E_1 by heating it at point E until it melts, and gradually pulls it out to the form D as shown. Fig. 4 shows the exhausting laboratory. In this picture there is shown the apparatus where the mercury tubes are exhausted. A is an asbestos cylinder or shell in which the tube is placed while the air is being pumped out. B is a furnace producing a hot-air blast blowing into the chamber A. C represents the tube coming from the air pump located in the basement and connected to the glass tube. D denotes the mercury trap.

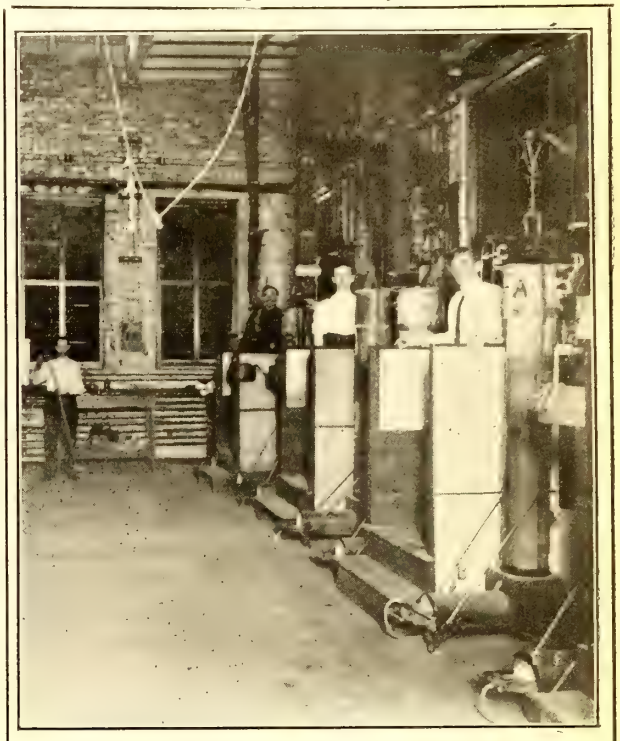


Fig. 4. Exhausting the Mercury Vapor Lamp Tubes.

The tubes are now finished and are brought to the testing room. Here each tube is carefully tested in every respect, both physically and electrically. They are first examined to see if they contain any mechanical defects. If so, they are placed aside and repaired, while the others are placed on a testing frame. Here they are kept for several hours while each tube is critically watched by experienced men. Every tube before being sent out is thoroughly tested, thereby assuring the consumer of a perfect product.

The tube is not the complete lamp, which includes a controlling device which momentarily tilts the tube automatically, while some tubes are self-starting. This is done by using a "kick apparatus," as it is termed technically. Various kinds of resistance and magnet coils are made in this plant for the mercury vapor lamps also.

The tube is placed in a suitable frame, which also contains the electro-magnets for tilting the tube. This frame is shown in Fig. 3, and it also contains the proper resistance coils. If it is an automatic tube the frame would contain the automatic devices for that particular tube.

The second important thing is the value of the mercury tube commercially, as it is very efficient for photography, drawing, etc. It also gives, in special forms, valuable effects on alternating current, the latter being perhaps more interesting to the general experimenter.

Everyone is acquainted with the glaring light which the ordinary electric lamp emits. It has a sort of blinding effect and it also produces many shadows, due to its concentrated center of light radiation. These effects are entirely overcome by the mercury tube, because the surface of the tube is large, therefore giving a greater diffusion of light, which is, of course, more pleasing and less tiring to the eye than the ordinary incandescent electric lamp. For this reason the Cooper Hewitt mercury tube is now being extensively adopted in factories, drafting rooms, etc., where the shadows are most troublesome. The rapid effect of the light of these tubes on photographic plates makes it extremely valuable for use in photography, especially in motion picture studios and in blue-printing.

Another peculiar feature of the mercury tube is in rectifying alternating current into direct current; this form of rectifier is widely employed in auto garages where alternating current is supplied and batteries are to be charged.

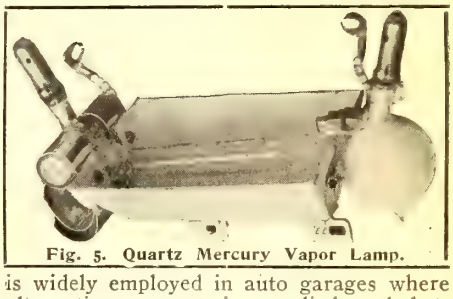


Fig. 5. Quartz Mercury Vapor Lamp.

One of the latest types of mercury tubes is the Quartz lamp, which is shown in Fig. 5. This tube works just the same as the

(*Continued on page* 151.)

A NEW HYDROGEN X-RAY TUBE.

By Frank C. Perkins.

The accompanying illustration, Fig. 1, and drawing Fig. 2 show the design of a unique hydrogen X-ray tube offered to Roentgenologists not as an experiment or a promise but as an actuality. It is claimed that the work with the hydrogen tube in several of the most prominent X-ray laboratories in America has substantiated in full the results in the Snook-Roentgen experimental laboratories on the new tube here shown.

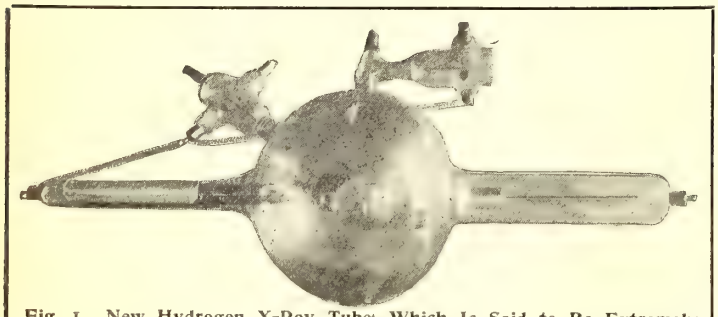


Fig. 1. New Hydrogen X-Ray Tube, Which Is Said to Be Extremely Efficient.

It may be stated that the pure hydrogen gas is the chemical means used for the regulation of the hydrogen X-ray tube. When the tube is to be lowered as to vacuum a current of approximately 25 milliamperes is discharged across a spark gap of about ⅛ inch long in a glass bulb containing chemically pure hydrogen. This spark heats to redness a metal osmotic tube. One end of the tub opens into the vacuum of the bulb proper (see Fig. 2), while the other is closed and prevents the hydrogen from entering the vacuum except when the metal, heated to redness, acts temporarily as an osmotic membrane.

The amount of hydrogen admitted to the vacuum is determined by the length of time the metal tube is kept red hot (and also by the temperature of the osmotic tube). The rate of diffusion through the metal increases with the rise in temperature, care being taken not to melt the metal. Hydrogen gas actually comes out of the tube when the vacuum is "raised," due to its own osmotic pressure, since ordinary atmospheric air contains practically no hydrogen.

It is stated that for continuous, heavy work no tube ever designed has given results equal to the *air-cooled* type of hydrogen tube. Compressed air, at about 4 pounds pressure, is used as a cooling medium for the air-cooled hydrogen tube. Both the anode and cathode are hollow almost their entire lengths to deliver the air to the inner extremities, as perceived from the cut.

The air delivered to the cathode serves also to cool the main glass bulb, as illustrated in Fig. 2. The vacuum control of the air-cooled hydrogen tube is identically the same as that of the standard type of hydrogen tube. The air supply necessary for operating the air-cooled hydrogen tube can be readily obtained from the compressed-air service of many hospitals and office buildings by merely connecting with the piping and installing a pressure-reducing valve. When this is not available a direct-connected motor and air compressor can be installed of the right capacity to care for the simultaneous cooling of two tubes.

It is claimed that results from day-by-day use of the hydrogen tube in X-ray laboratories over a period of many months have demonstrated that it will accomplish from three to five times more than any ordinary tube—in duration of service and in efficiency. Both in initial investment and in repair items a real economy is effected, and the more uniform operating characteristics of the tube give uniformly better results and radiographs that are uniformly good, while tests have proven that the focus point is very steady and does not wander.

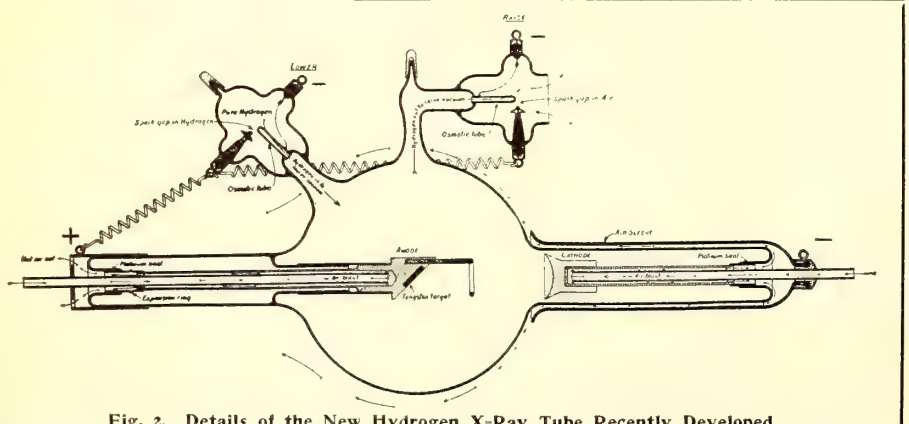


Fig. 2. Details of the New Hydrogen X-Ray Tube Recently Developed.

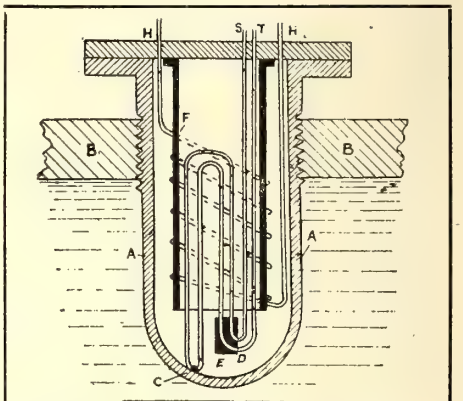
WIRELESS IN COURT.

Judge Mayer sat recently in the Federal District Court of New York City and listened to the wireless messages which were passing between vessels at sea and the land stations at Sayville, L. I., and Sea Girt, N. J. The apparatus, which had been set up in his courtroom, was erected to help him decide a patent infringement suit, brought by Samuel L. Kintner, receiver of the National Electric Signaling Co. against the Atlantic Communication Co.

The suit, which is highly technical, turns largely upon what experts call a "high frequency musical tone." It is alleged that the Atlantic Communication Co., in producing this tone by means of apparatus which has been made under the Telefunken or German patent, is infringing on the apparatus covered by the Fessenden patent, which belongs to the National company.

FEELING FOR ICEBERGS ELECTRICALLY.

It was after the disaster of the *Titanic*, when inventors realized the importance of an instrument which would notify the navigating officer of some approaching iceberg. Many different devices were invented for this purpose, and one of these is herewith described, its action depending upon the thermo-couple or electric thermometer principle.



Electrical Device Tells the Approach of Icebergs.

Looking at the accompanying sketch, a "thermo-couple" ST is mounted inside a metal capsule A, which is screwed through the ship's hull plate B. One junction C of the "thermo-couple" is soldered onto the shell A, and hence rapidly assumes the same temperature as the water outside. The second junction D, however, is imbedded in a block of material E, which permits it to assume slowly the temperature of the air inside A. The free ends of the wires ST are connected to a sensitive relay; the wire HH is wound around the insulating tube F and serves for heating purposes. At ordinary times the contacts CD are both at the same temperature, hence no current flows through ST and no alarm is given. But when an iceberg is approached the temperature of the water varies repidly and the junction C is cooled much more quickly than the junction D. As a result a "thermo-electric" current is set up, and this operates the relay, which in turn closes an alarm circuit and warns the navigating officer of the impending danger.

A NEW VEST POCKET AMMETER.

A novel, compact type of pocket ammeter has been developed by the Benford Manufacturing Co., of Mt. Vernon, N. Y. As perceived from the illustration of same, it is a metallic barrel, inside of which is a coil of magnet wire. When the tip on the flexible cord and the second tip on the base of the instrument are placed in contact with a source of current, such as a dry cell, the calibrated iron plunger in the center moves inward in proportion to the amount of current passing through the coil. The idea is old, but the make-up of the instrument as a whole makes it very serviceable and free from derangement.



The voice by telephone travels from New York to San Francisco in 1-15th of a second, traveling at the rate of 56,000 miles per second. The voice of a man speaking in New York is heard in San Francisco three hours earlier, that being the difference in the standard time of the two cities.

How to Build an Electric Writing Machine or Telautograph

By Homer Vanderbilt

THE telautograph is an electrical machine by which handwriting may be transmitted electrically over wires. Many articles have been published on the telautograph, but in these the interest of the novice has been rather neglected if he should want to build a simple electric writing machine. It is the object of this short article to show the experimenter, with drawings and general explanation, how to construct one.

The details for the construction of the

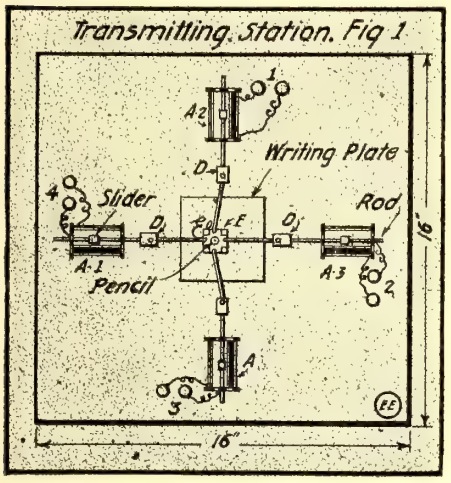


Fig. 1. Transmiting Apparatus for Sending Script Messages Over a Wire.

individual parts are given in the accompanying drawings. These do not require much description. Fig. 1 represents the transmitting station, which consists of four resistance coils at right angles to each other and their sliders moved by brass rods, which are joined together at a common point E, where a pencil or pen is attached. These rods are swiveled by means of universal joints D, D, D, D.

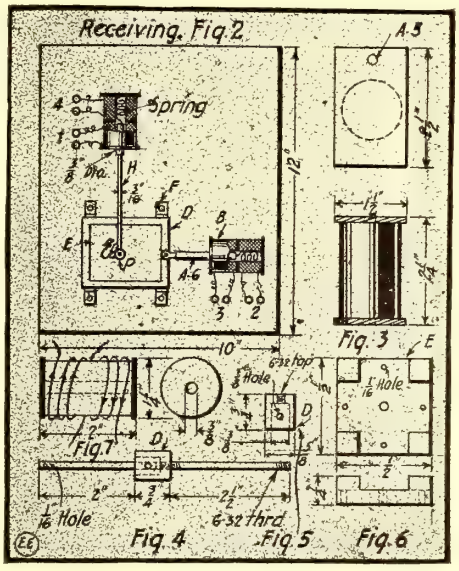
The resistance coils A, A1, A2, A3, are wound with No. 26 B. & S. German Silver wire on wooden cores as shown in Fig. 3, and well shellacked. Ordinary tuning coil sliders are then placed on top of the coils. Four of these resistance coils are made and then fastened to a wooden base 16"x16"x ¾", by means of wood screws. These coils should be placed at right angles to each other, as shown in Fig. 1. A small hole is drilled on the back end of each slider and threaded with a 6-32 thread. Now construct the slider rods, which consist of two pieces of brass rod threaded together by means of a universal joint D. The slider rods are now inserted in the end holes A5, Fig. 3, on each side of every resistance coil bobbin. The details of construction of rods are shown in Fig. 4, and of universal joints at Fig. 5. All parts are made of brass. After the coil and rods are made and assembled on the base, connect all the rods at a point E by means of a brass center block shown in Fig. 6. Four small pins are inserted in each hole through the rods so as to allow a free play between the rod and connector. Each set of terminals of the coils are connected to their respective binding post as indicated.

The receiving apparatus is similar to the transmitter but different in construction. The receiver consists of two solenoid type electro-magnets arranged as shown in Fig. 2. These solenoids have two sets of windings on them, and wound in opposite directions. The two bobbins are made of hard rubber and details of dimensions are shown in Fig. 7. After the bobbins are made according to dimensions, wind in one direction and one-half of the spool, with 200 feet of No. 24 B. & S. copper magnet wire, and then wind the other half and in the opposite direction with the same amount and size of wire. Both coils should be wound exactly the same. Now construct the movable cores, which consist of two pieces of soft iron 1¼"x⅜" in diameter. On one end of these cores a No. 10-32 thread is made and a small brass rod H with No. 10-32 thread on one end is inserted, as shown in Fig. 2. Two small springs are then placed behind each end of the cores of the solenoids as shown.

The *writing board* E, Fig. 2, consists of a thin brass plate 8"x4"x¼", placed between four brass angle pieces F, suitably grooved, so it can be moved easily by the electro-magnet arm A 6, Fig. 2. This arm A 6 is the core of the electro-magnet B and is made from soft iron 2½"x⅜". A small hole is made in one end in order to attach it to the *writing board* E.

Now place these parts on a hardwood base 12"x10"x½" and arrange them as shown. Connect the respective coils to a pair of binding posts. The apparatus is now ready for use. Connect both transmitter and receiver as follows:

Binding post 1 of sender connect to binding post 1 of receiver and binding post 2 of sender to binding post 2 of receiver, and so with 3 and 4. It is to be remembered that a battery is connected in series with each set of connections. About four cells in each circuit will work very nicely. Draw a figure on a piece of paper and then place it on the transmitter writing plate

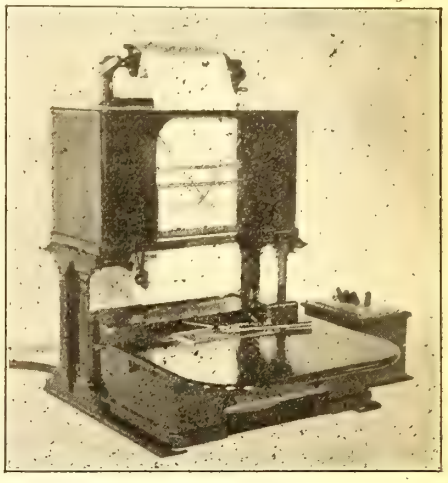


Details of Various Parts Constituting the Home-Made Telautograph.

and trace it by means of the pencil. A piece of paper is now attached to the *receiver writing plate* and a pencil inserted on the rod hole P and laid loosely on the paper. As soon as the transmitter pencil moves the receiving pencil will follow and in this way it will reproduce the exact image. Writing may be sent over the wire just the same.

The principle which this machine depends upon is the variation of resistance which the transmitter's resistance coils create by the movement of the sliders and thereby causing a different current strength to pass through the receiver solenoids by which the iron core is directly affected by the varying changes of current.

A little practise will be necessary at first



Commercial Form of "Telautograph" as Used in Banks, For Transmitting Signatures.

before good results are obtained. This machine in commercial form is now used in banks, hotels, etc. The writer will be very glad to hear from the readers of any trouble that they may have in constructing this apparatus. He will also answer any questions regarding its operation and construction if addressed in care of the Editor.

HOW TO HANDLE HARD RUBBER.

Hard rubber is one of the most frequently used materials by the electrical experimenter; first, because of its excellent insulating qualities, and second, it is easier to handle than porcelain or similar hard materials. Nevertheless a great deal is often wasted before the desired results are accomplished.

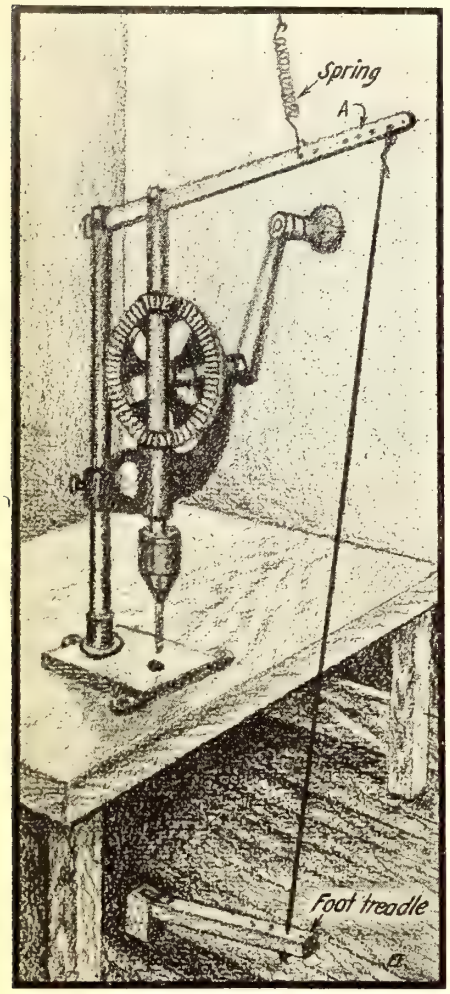
Hard rubber can be cut without chipping with a hacksaw or a fine-tooth saw. If it is cut more than half way through on one side, then starting on the other side until the cuts meet will avoid chipping. The pressure on the saw should be very light or the rubber will crack. Rubber can be drilled with ordinary twist drills in a drill press, but the stock should be laid on a perfectly flat surface and a very light pressure exerted on the drill. When finishing a base it is often desirable to have the edges rounded. This can be done with fine sand paper. To obtain a dull finish at the top it should first be sand-papered and then washed. A brighter finish can be obtained by mixing a little emery with oil and polishing the surface with it.

In working with hard rubber it is better to have it fastened to a solid support so that the drill or saw will not bend, which will cause the rubber to crack.

Contributed by OSBORN FINN.

A FOOT-CONTROLLED DRILL PRESS.

In the small hand-feed drill presses it is necessary to place the work in a vise to



Foot Treadle Control of Hand or Breast Drill.

hold same while drilling. Very often the work could be done much more quickly and conveniently if both hands were free to hold the work. The sketch shows how this may be done. The feed is simply changed from hand-feed to "foot-feed." In the small sizes it is only necessary to drill two or more holes in the handle A and attach the treadle. In the larger sizes it may be necessary to rivet a piece of strap iron to the handle so that sufficient leverage can be obtained.

The pedal may be 2 feet or more in length, and a number of holes should be drilled in one end so that the leverage may be changed. A strong cord, chain or wire is fastened to it as shown; a hinge properly placed will allow the pedal to be thrown back under the bench out of the way when not in use.

A spring (from a window-shade roller) is good if fastened as shown to keep the drill normally above the work. Contributed by FRED'K J. SCHLINK.

WIRELESS TELEGRAPHY A DISCOVERY—NO INVENTION.

Professor Pupin, testifying in court, avers that Marconi discovered wireless by accident in the grounding of two wires. This, if so, in no wise detracts from the value of the discovery, nor does it constitute something unheard of before in the scientific world. Didn't the fall of an apple from the tree reveal to Newton the law of gravitation?

LIGHTNING'S PRANK TURNS TROLLEY POLE INTO WATERSPOUT.

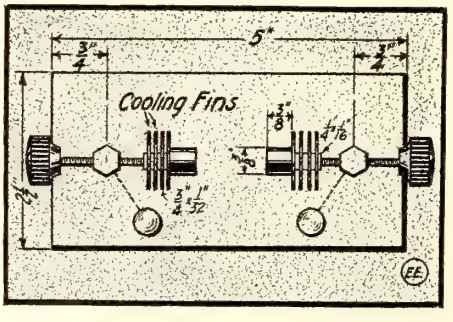
Lightning struck a tubular steel pole supporting trolley wires in New York City recently, burning the wires and messengers loose and allowing them to fall into the street. A few minutes later water began to spout from the top of the pole and to ooze from the joints, making the pole a veritable fountain. Investigation showed that the lightning had ruptured a water main beneath the pavement, and that the path provided by the tubular pole was the only means of escape for the leaking water. Since to shut off the main would have deprived a large district of its water supply, the impromptu fountain was allowed to run during the night, and the main was repaired next day.

SPARK GAP WITH COOLING VANES.

An efficient spark gap with radiating fins has not only a necessary place on the wireless table but it gives the appearance as well as the qualities of a commercial station. The commercial gap with radiating fins is in many cases beyond the pocketbook of the experimenter, so something else has to be substituted.

The drawings show the general construction of the gap, but a few words of explanation may not be amiss. The base is made preferably of marble or hard rubber, but can also be made of any hard wood, and is 5x2½x¾ inches. Holes are bored and countersunk for the screws that hold the hexagonal uprights and for the binding posts, and grooves made for the connecting wires. The hexagonal brass pillars that support the gaps are 1¼ inches high. The holes through which the threaded rod passes are ¼ inch from the top and tapped with an 8-32 screw thread. Holes are also drilled and tapped in the bottom of the pillars for the screw which holds them to the base. The pillars are placed 3½ inches apart, giving a gap of 2 inches, which is more than you will probably need. Each piece of the threaded brass rod is about 2 inches long.

Regular zinc spark-gap ends are used. These are tapped to fit an 8-32 thread. The radiating fins are cut from sheet brass or copper 1/32 inch thick. These are drilled to pass the 8-32 thread, or may be tapped and screwed on, which insures a more solid and heat-efficiency construction. These are separated by ¼x⅛-inch hexagonal brass



Spark Gap Cooling Enhanced by Washers Acting as Vanes.

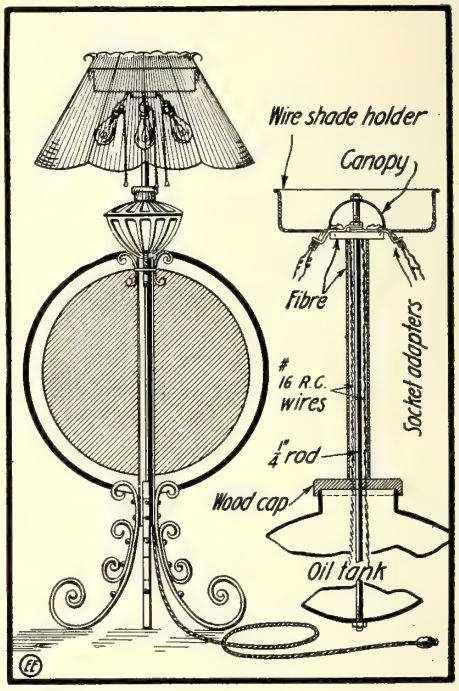
nuts. These are screwed up tightly against the fins and one should be put behind the last fin. Do not polish the surfaces of the fins, as this tends to reduce the radiation. They may be painted with aluminum paint if desired.

Hard-rubber binding posts and knobs add a finished and neat appearance to the instrument.

Contributed by JAMES W. LOWRY.

ELECTRIFYING AN OIL PIANO LAMP.

Having one of the old style, but artistic, type of oil piano lamps on hand, the writer conceived the idea recently of converting this into an electric lamp. The accompanying drawing shows how this was done, and in the writer's case it was wired for three sockets. Chain-pull sockets are best employed, and thus one or more lamps can be lighted as desired. The detailed sketch shows how the upper part of the lamp



Converting Oil Piano Lamp Into Electric Type.

was converted to support the three electric sockets. First, the three sockets were secured together on a round fiber disc ¼ inch thick by three inches in diameter with three gas-electric adapters. These adapters, which have flat brass legs on them about 3 inches long, were bent, as shown, so as to support the three sockets at an angle downward. The three tails of the socket holders were held under the brass nut at the end of the ¼-inch threaded brass rod indicated, which passes up through the oil tank and fiber tube. The fiber tube was about 1 foot long and ⅜-inch bore by 1 inch outside diameter. No. 16 rubber-covered fixture wire may be used to lead up through the stem of the lamp, a piece of flexible lamp cord of whatever color silk finish desired being secured to these No. 16 wires inside the lamp.

A wire framework to support the silk-draped shade shown was fastened also under the nut on top of the rod which clamps the fiber disc and socket holders. Undoubtedly there are many readers who have one of these lamps of the oil type lying around, and it can thus be changed into an electric type, and, with a new style shade on same, made of fabric, etc., it will make a very artistic addition to any parlor or drawing room. This particular lamp was finished up with some dull black Japalac all over. The shade was of pink china silk, artistically ruffled or draped.

Contributed by A. SHUTTE.

DESTROY WIRELESS STATION.

British troops destroyed the important fort and wireless station at Bukeba, on Lake Victoria-Nyanza, German East Africa, on June 25, the Government bureau announced.

A TRIP THROUGH THE COOPER-HEWITT ELECTRIC WORKS.

(*Continued from page* 147.)

quartz tube it thereby gives a greater amount of light for its size. This lamp is used where longer lamps cannot be used. It is also of special benefit in electro-therapeutical applications.

The latest use of the mercury tube is in wireless telephony. Dr. Peter Cooper Hewitt has found out that, when specially built, they develop a high-frequency current when they are excited by an alternating current, and successful results have been obtained in this line. Dr. Hewitt expects to develop his system to such an extent that ordinary persons will be able to handle his wireless telephone apparatus just the same as the ordinary wire telephone used to-day.

NEW USES FOR ELECTRIC LIGHTS.

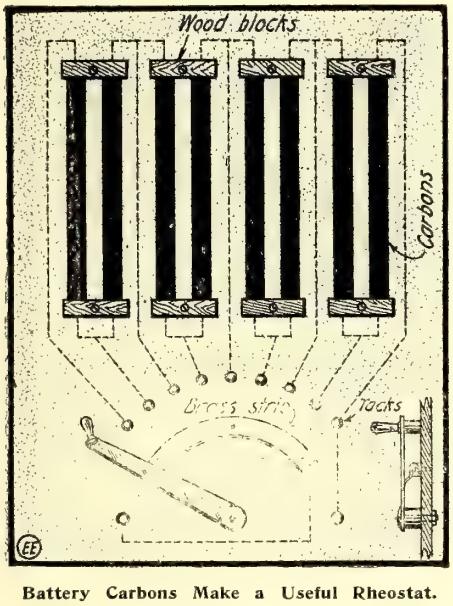
Anyone suffering from earache, toothache, neuralgia and possibly other ills will often obtain relief by taking an electric light—one on a pulley—to bed with them. Place the bulb on the part affected and it will very often ease the pain. This is a very handy way to get relief when stove fires are all out and the rooms cold.

My son once used an electric fan to cool a kettle of soap he was cooking to keep the soap from boiling over! It worked splendidly, too. It could be used in cooking jelly.

Contributed by
MRS. ELLIOT ROSS.

A CHEAP CARBON RHEOSTAT.

The construction of my home-made rheostat is as follows: On a board about 5 inches wide, ½ inch in thickness and 8 inches long fasten 8 brass-headed tacks for switch points, about half an inch apart. Or better yet, procure a drill and make holes through the board. Then in each one fasten



Battery Carbons Make a Useful Rheostat.

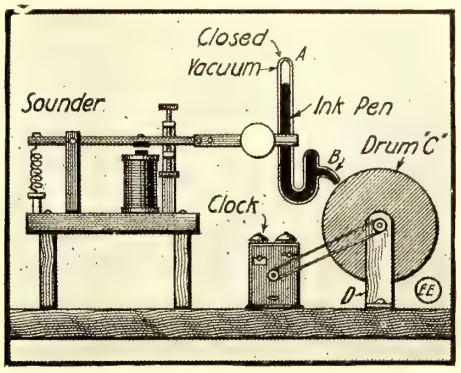
a binding post from a carbon rod of a dry battery. Now procure a circular-shaped brass strip as seen in the illustration. Get a switch handle and fasten same in position as indicated. For the resistance procure 8 sticks of carbon either from small flash-light batteries or dry cells. These carbon sticks are fastened by small blocks of wood screwed on board. String the wires under the base and make the other necessary connections with some bell wire.

Contributed by JOHN HENRY.

ROOM ENTRANCE RECORDER.

Herewith are given directions for the construction of a novel and simple device to announce that an entrance has been made into a room.

First secure a telegraph relay or sounder, and on the armature place an inker. Below, where the hammer strikes, place a paper-covered drum, as shown. In the normal position the sounder armature containing the inker does not touch the paper. In



Room Entrance Recorder With Siphon Pen.

other words, the sounder is open. Connect one pole of the sounder to one battery pole and run a wire from the other pole of the sounder out under a carpet directly in front of the door. Then take another wire from the pole at the other end of the battery and lay it across the first wire under the carpet. Cross one of the wires over the other, but make sure that they do not touch.

When a person steps on the carpet in the act of entering the room the two crossed wires are pressed together by the weight of the foot, thus closing the circuit and actuating the sounder. The inker and hammer come in contact with the paper covering the drum, thus making a mark on same, and thus the record is made.

Different inking devices may be used, and the longer the ink supply lasts the more useful becomes the apparatus from a time-saving aspect.

As depicted in the sketch, the inker is simply a siphon-type glass tube drawn out to the shape indicated. It retains the ink by atmospheric pressure, there being a partial vacuum at the top of the sealed-up end A. Invert ink tube when filling. A "pen" point may be drawn out as at B. This principle is used on several commercial recorders. The paper-covered drum C may be a baking powder tin suitably mounted on standard D D. It may be driven by a clock motor, as shown, the drum C being arranged to rotate, say once every 12 hours, etc. Some burglar alarm matting works very well for the circuit closer.

Contributed by WARREN BAKER.

J. HOWARD MASON WIRELESS EXPERT.

Green Island, N. Y., has a prodigy in the person of J. Howard Mason, of 20 Hudson Avenue, eighteen years old, a specialist in wireless telegraphy and an electrical expert with a brilliant future. He is the son of Edward A. Mason, foreman of the passenger equipment departmen of the Delaware and Hudson shops in Colonie. A graduate last June of the Whitehall High School, young Mason intends next year to enter the Rensselaer Polytechnic Institute, a candidate for the degree of electrical engineer. The Masons moved to Green Island from Whitehall last May. From the roof of the Mason home to the roof of the nearest house on the south stretches the wireless apparatus, which has attracted considerable attention. The clocks and watches in the Mason household are regulated by government time, received by wireless from Washington every noon. The receiving end of this wireless system is in the basement of the Mason house, and the receiver itself consists of two telephone receivers which young Mason adapted. They work just as well, he says, as the regular expensive receivers. When young Mason was at Whitehall and had more time to spend on wireless telegraphy, he used to receive messages from as far as Charleston, S. C., and if the apparatus in his own house now were adjusted to its full capacity he could, but he would not, because it is against the law, send messages 100 or 150 miles. Young Mason, who this year is working for The Delaware and Hudson Company, spends his evenings in his laboratory, located in the basement, experimenting either with his wireless or with various electrical phenomena.

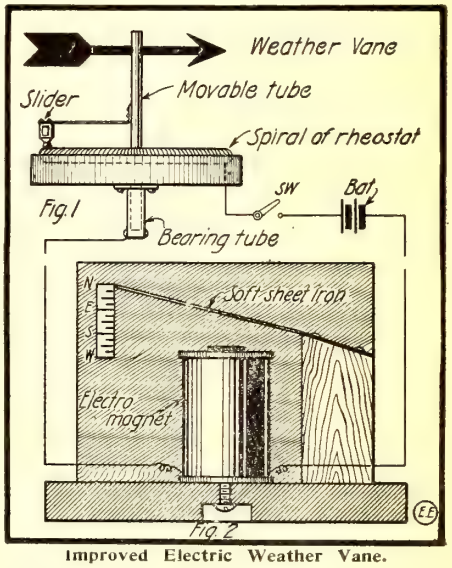
IMPROVED ELECTRIC WEATHER VANE.

I have seen many descriptions of electric weather vanes, but find fault with most of them. Some work with lamps, others with bells, and still others with magnets; but the common fault is the complexity of wires.

If four points of the compass are indicated, five wires are necessary; if eight points are indicated, nine wires are necessary. Besides this complexity of wires, the cost is quite heavy when wiring a four or six story building for this kind of apparatus.

It seems to me that the use of one or two wires is cheaper and simpler than that of five or nine wires.

In the type of vane illustrated here the movable axle to which the vane is fastened rotates a ball-bearing slider around the spiral of an ordinary rheostat. In the apparatus room a device similar to that shown in Fig. 2 is installed. By connecting a battery of two or three dry cells in series with the rheostat and indicator the



Improved Electric Weather Vane.

direction of the wind is acertained by the indication of the "dipping" needle on the scale.

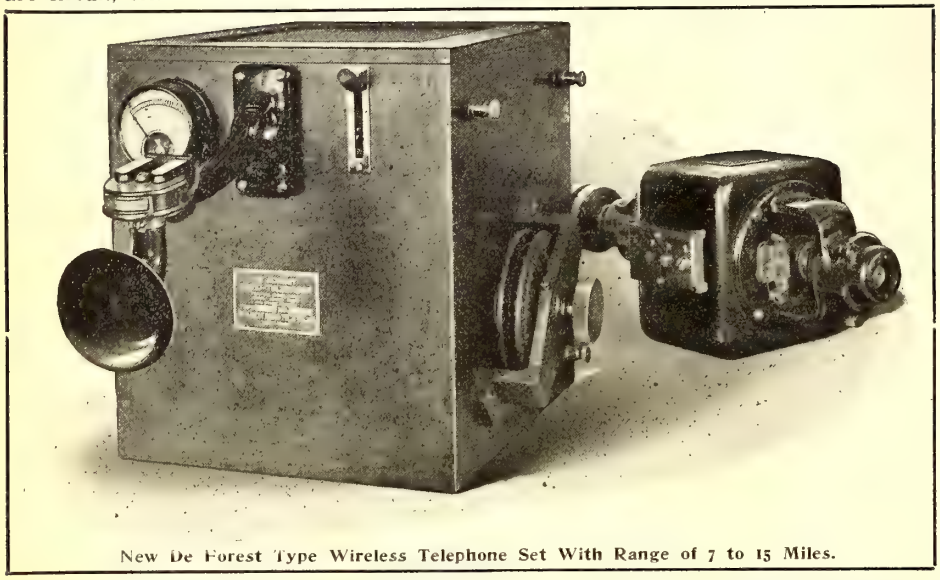
The scale calibrations must be made by experiment, as they differ in proportion to size, ohmage of magnet, current, etc. This necessitates the use of but one wire if the other is grounded. Contributed by
JENKINS SMYTHE.

WIRELESS DEPARTMENT

A New 100-Watt Wireless Telephone

One of the latest productions of the De Forest Radio Telephone & Telegraph Co. is a small-size wireless telephone outfit of improved type, which bids fair to find extended commercial application. The illustration shows the complete transmitting equipment, which comprises a special form of arc gap, together with heavy current microphone, regulating apparatus for the arc circuit, etc.

In the diagram here shown K is a large-size choke coil in the dynamo circuit, and a switch is indicated at S. The arc gap is placed at AG. An oscillatory circuit, of course as usual, composed of a condenser C, with inductance or helix H, is shunted across the arc gap AG. A heavy current microphone into which the words are spoken may be connected in the ground wire at M or in some other part of the

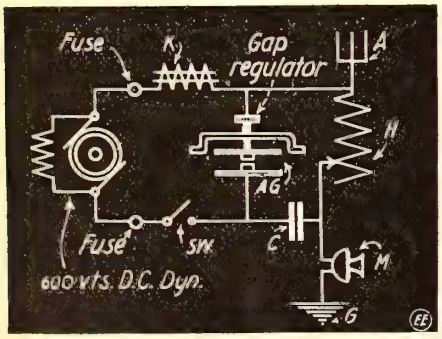


New De Forest Type Wireless Telephone Set With Range of 7 to 15 Miles.

The arc is operated from a small 600-volt D. C. dynamo, which is also shown in the illustration. This machine is driven by a gasoline engine or electric motor, whichever may be convenient.

Considerable tests have been made in the past few months of this radiophone transmitting set around New York City, and it works very well indeed. It may be said that the principal feature is the arc, and this takes place between the two platinum buttons or electrodes of small size, which are mounted on two large copper or other good heat-conducting plates. These will be observed mounted on the right-hand side of the transmitter cabinet.

A schematic diagram is given, which shows the general arrangement of these new sets, and in some of the larger sets, supplied for ship service in transmitting undamped radiotelegraphic waves, the arc is started by momentarily short-circuiting the dynamo through a large choke coil and a switch. This new set, however, is claimed to be self-starting as regards the arc, and this can be managed in several ways, such as temporarily reducing the length of the arc gap, etc.



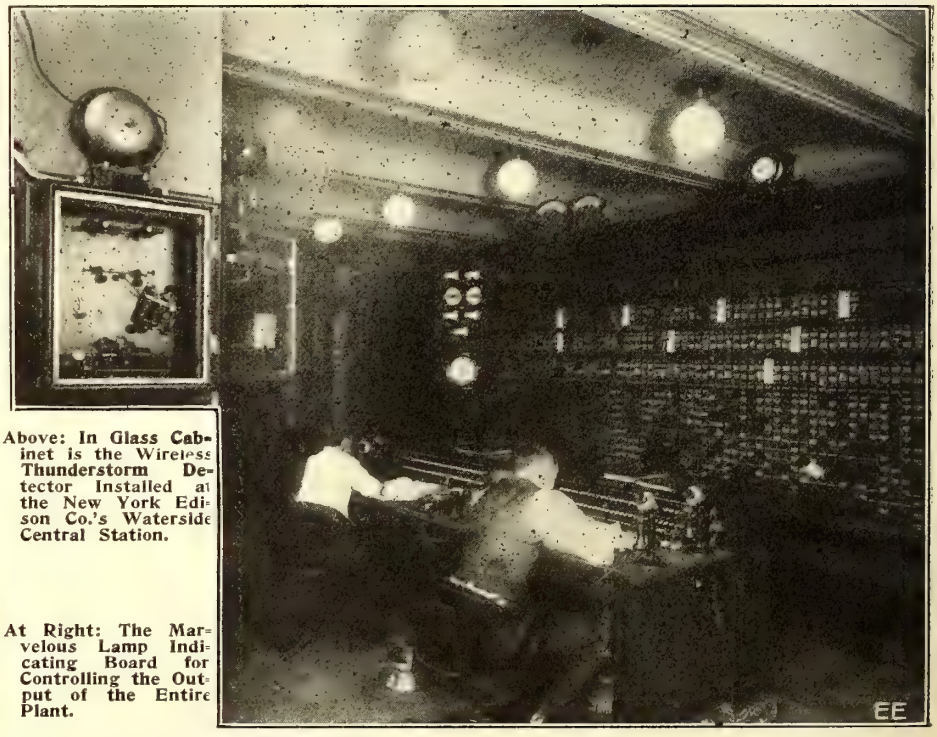
Schematic Diagram Showing Relation of New Radiophone Apparatus.

circuit. This set will talk from seven to fifteen miles.

WIRELESS STORM DETECTOR IN CENTRAL STATION.

The most interesting apparatus at the Waterside station of the New York Edison Co. that may appeal to the experimenter is the wireless storm detector shown in the photograph. It is an ordinary radio receiving outfit of the coherer type. The use of this outfit in the station is to inform the chief operator of an approaching electric storm. Any storm that may occur a few miles away is recorded by this detector and transmitted to a sensitive relay which relay closes a secondary circuit operating a large electric bell. Whenever electric storms approach the day load is increased on account of more lamps being used. It was noted at the Waterside station that during some storms 60,000 kilowatts in five minutes' increase in load occurred.

The other part of the photograph represents the centralized control switchboard of the same powerhouse. (The switchboard of any power plant is really its brain; just as the human brain is the control center of the nerves in the body.) The various numbers on the switchboard, as seen, indicate the supply feeder numbers. Two buttons are located under each number, so that by pressing one button the operator may supply or cut off power from that particular feeder. The main switches and meters are located in a separate room. There are also two miniature electric lamps under each number, one red and one green. These lamps are used to call the operator's attention, whether to supply or disconnect any particular feeder. Thus the absolute control of thousands of horsepower is placed in the hands of one or two men.



Above: In Glass Cabinet is the Wireless Thunderstorm Detector Installed at the New York Edison Co.'s Waterside Central Station.

At Right: The Marvelous Lamp Indicating Board for Controlling the Output of the Entire Plant.

ANOTHER BOOST.

Says J. R. Rickman, of Greenville, S. C.: "I received my first copy of the *Electrical Experimenter,* and I think it is the best magazine I know of. It contains useful hints and many other interesting points, and is well worth the sum that you ask for it."

A British officer who was a prisoner on board the German raider "Kronprinz Eitel Friedrich" reports that although the Germans' wireless outfit was limited to a 900-mile radius, they sent up 8-foot kites connected by a fine wire with their wireless receiver, and in this manner picked up messages from points 2,500 miles away.

NEW 1½-2 KW. RADIOPHONE ARC GENERATOR.

A specially built and efficient type of wireless telephone arc generator of the *Electro* type is shown in the illustration. This arc measures 24 inches high over all and takes up 12 by 12 inches table space.

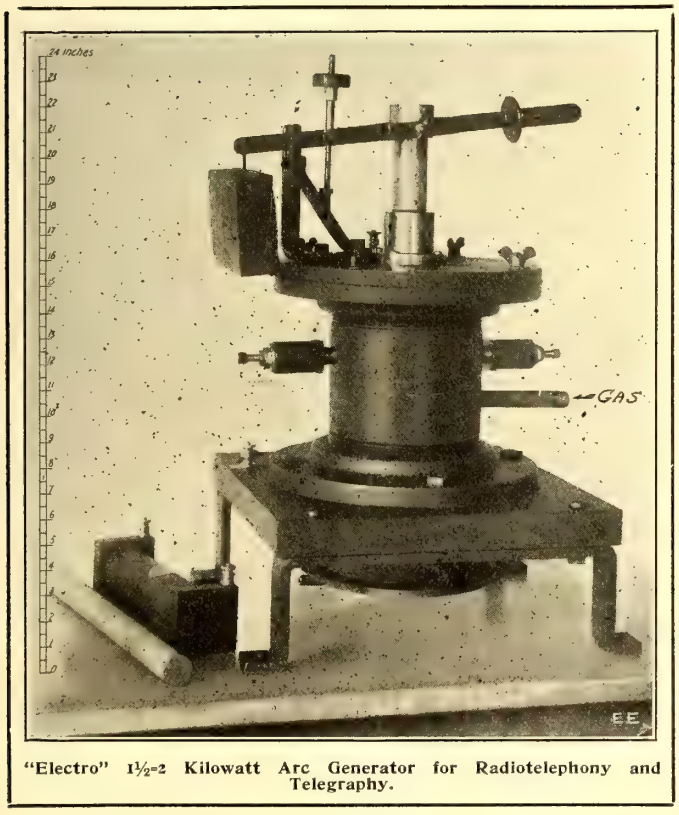
The arc is designed to operate on 110, 220 or 500 volts D. C. and may be used for producing high frequency oscillations for radiophonic or radiotelegraphic requirements. In the latter case, of course, a *tikker* or *tone wheel,* etc., will have to be used at the receiving station in order to pick up the undamped waves as radiated by the arc excited antenna at the transmitting station.

This particular arc has a substantial steel gas jacket on same, measuring 5 inches in diameter by 8 inches in height. This jacket is provided with gas feed pipe, as observed on the right side of the jacket cylinder, and also it carries two special low pressure quick-acting safety valves to relieve the sudden rise in pressure within the gas jacket whenever the gas in same is exploded by the action of the arc.

The upper sliding electrode with screw hand feed carries a solid carbon of large size, while the lower or positive electrode is a water-cooled copper affair of ample proportions. This positive copper electrode is placed in a powerful co-axial magnetic blast field, supplied by a substantial electro-magnet coil mounted under the base of the arc, as will be observed from the photograph.

A balance weight holds the top lever and also the upper carbon electrode carrier in an elevated position and the carbon is fed downward, as required in operating the arc, by the small feed handle shown. The crosswise lever works freely by means of a sliding boss on the threaded feed rod, so that by striking downward the outer handle on this crosswise lever with the hand the arc can be quickly started and the carbon allowed to rise again quickly. The length of the arc is adjusted by turning the feed screw as required.

Illuminating gas is used in most cases for this type of arc, and this gas has been found very efficient for the purpose after much research work by the Federal Telegraph Co. The coil shown in the picture alongside of the arc is the choke coil used in the direct current feeding circuit to prevent the high frequency oscillations generated by the arc from passing back into the dynamo circuit, etc. A suitable inductance and condenser are shunted across the arc, as usual, to form an oscillatory circuit, and this is linked with the aerial oscillating circuit either conductively, as by using a helix, or inductively, involving the use of an oscillation transformer.



"Electro" 1½-2 Kilowatt Arc Generator for Radiotelephony and Telegraphy.

Up-to-date Wireless Set of the S. S. "Olympic"

A very complete wireless set is shown in the illustration as installed on the steamship *Olympic,* one of the largest ocean greyhounds. This set, of the Marconi type, is capable of keeping the gigantic leviathan of the seas in radio communication with both shores practically all the way across the ocean. The motor generators and other heavy apparatus are installed in a separate room and control lead wires, come through the partition, as will be observed, to the manipulating resistance boxes and switchboards containing the volt and ammeters.

Also a pneumatic message tube, as well as speaking tube, communicates with the captain's cabin, and with the bridge of the vessel.

The transmitting set is rated at several kilowatts and employs a high frequency generator, which gives a musical note. Proper grounding devices are used to dissipate any static kick-back surges in the transmitting circuit, etc. These are mounted on a separate panel.



Excellent Marconi Radio Set on the Ocean Steamship "Olympic."

The receiving apparatus embodies the latest style multiple valve tuner of the Marconi type, as will be observed at the center of the instrument table before the operator, who is seen in the act of receiving a wireless message from shore when two days out. A magnetic detector is used, and this is observed mounted on the wall in front of the operator.

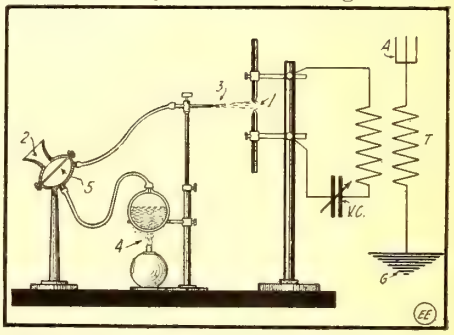
The usual auxiliary ship sending set is installed on the instrument table and comprises a 10-inch spark coil with suitable batteries, etc., for operating same in case of emergency or wreck.

The radio station on ship board to-day is certainly a wonderful improvement over those used in the early days of the art, and conjointly, also, their efficiency and operating range is much greater in every case, enabling the ship to communicate over distances of 1,000 to 1,500 miles with ease.

A NOVEL IDEA FOR WIRELESS TELEPHONES.

There was recently issued a patent to a New York City inventor covering a rather novel method for controlling the arc current in wireless telephone transmitting stations. In substance this idea is as follows:

As will be seen in the drawings, arc "1" is used to produce high-frequency oscillations. These are transmitted to the aerial



Novel Scheme For Controlling Radiophone Arc by Varying Stream of Hydrogen Gas.

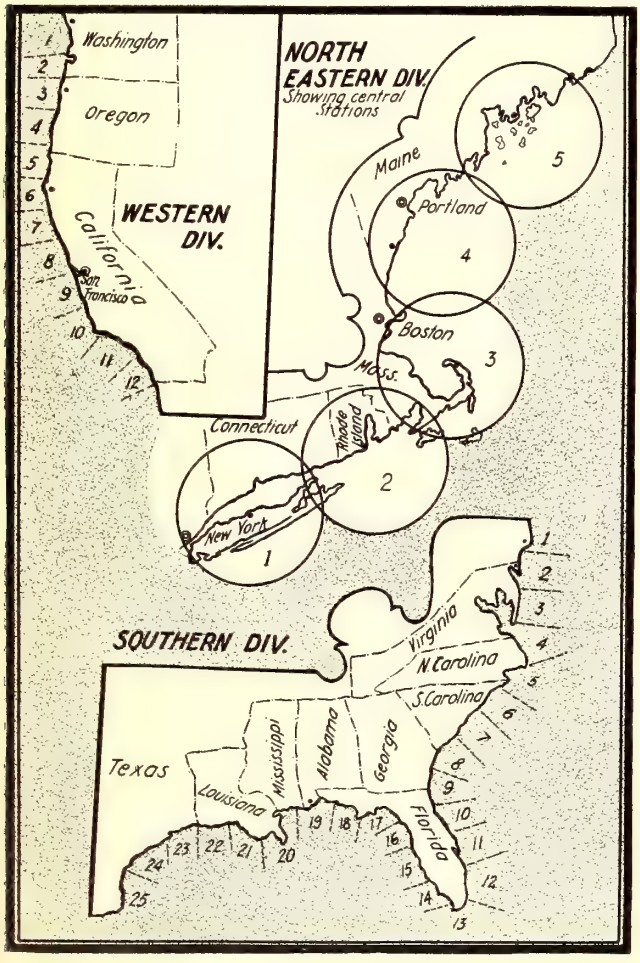
and ground "A" and "G" as usual, through the oscillation transformer "T." As is well known, it is always a considerable problem to properly impress the voice waves on the high-frequency circuit.

This inventor has very ingeniously arranged a talking mouthpiece and diaphragm "2" so that every movement of the diaphragm will cause a varying amount of hydrogen gas to be injected into the arc chamber through the nozzle "3," as will be observed in the sketch. Most wireless telephone arc generators, of course, employ a gas envelope surrounding the arc proper, and this has a decided effect on the arc. Therefore, by taking advantage of this function of the gas, this inventor has provided a very simple method which seems indeed quite practical for controlling the strength or degree of oscillations produced by the arc generator.

The small vessel with spirit lamp under it at "4" is the apparatus for producing the gas, which then passes through a rubber tube to the gas chamber "5," and so on through another rubber tube to the nozzle "3."

A RADIO SCHEME FOR PROTECTING U. S. COAST LINE.

A UNIQUE wireless scheme was recently brought forth by John Hays Hammond, Jr., of wireless torpedo fame, for the protection of the entire United States coast line on both the Pacific and Atlantic shores. This scheme involves the building by the United States Government of about 44 scouting aeroplanes of large size, adapted to carry powerful wireless transmitting and receiving sets. Each of these 44 scouting aeroplanes would cover a zone of its own, as shown on the appended map layout. This sketch will help to convey Mr. Hammond's idea to the reader, and it indeed seems quite feasible.



John Hays Hammond Jr.'s Radio-Aeroplane Scouting Scheme for Our Costal Defense.

Moreover, the cost is not anywhere near as excessive as that involved in building a tremendous navy of dreadnaughts and other ships, some of which cost as high as $15,000,000 apiece.

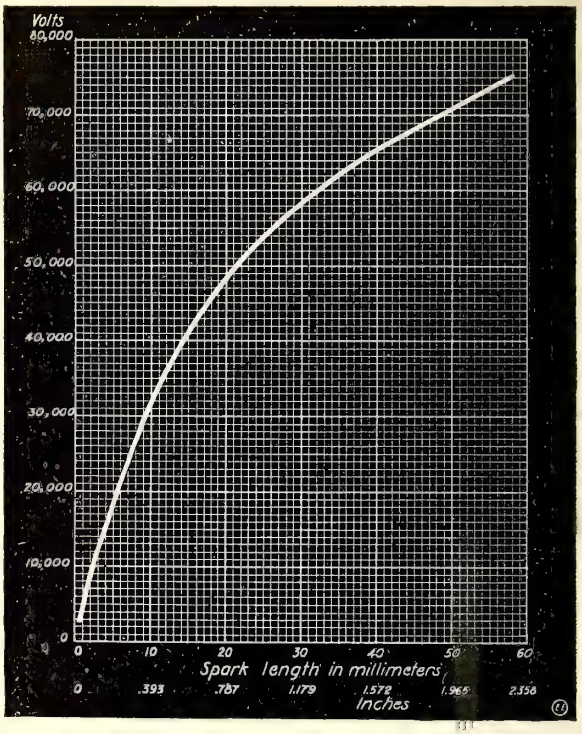
Briefly, it may be said that from the inventor's figures, covering cost of wireless apparatus for each aeroplane, aeroplane sheds or hangars, etc., the total cost of the 44 scouting aeroplanes complete, ready for service in the event of war, would be $398,500. He suggests, also, that the Chaffee system of wireless telephony would be very well adapted for the work, as it is simple in operation, very compact and light, and also requires no knowledge of the Morse telegraphic code, as does wireless telegraphy.

The Chaffee system also gives a large power in small aerials, is capable of being very sharply tuned and is remarkably cheap from a constructional standpoint.

The general operation of this scheme is to provide, of course, a small wireless station at the center of each zone point along the coast, and this would be in communication with the chief military headquarters. It is thus pointed out that the approach of any foreign naval fleets or transports would be perceived a considerable space of time ahead by the aeroplanes and that by transmitting this intelligence wirelessly to the military authorities in charge the enemy could be met by a powerful home fleet in an effort to quickly destroy the hostile vessels.

SPARK POTENTIALS.

Probably every "electrical experimenter" has often wondered how great the difference of potential might be between the secondary terminals of his induction coil or the knobs of his static machine when a spark of given length was passing. Unfortunately, no definite voltage can be ascribed to a jump-spark discharge, partly for the reason that the resistance of the air-gap between the electrodes is far from constant, for the material, size and shape of the terminals themselves play an important part, as do also changes in barometric pressure and various radiations that may traverse the space containing the spark. Inasmuch as most experimenters do not possess the requisite apparatus for measuring these potential differences directly, they must content themselves with an approximate determination based on the measurements of others. It is often stated that the potential difference is directly proportional to the length of the spark, and that it increases at the rate of 30,000 volts per centimeter of spark length. This is only approximately true for sparks of less than 2 or 3 millimeters in length, and where the knobs of the electrodes are large compared to the distances between them. As the length of the spark is increased, the increase in the potential difference is much less than that stated above, so that no idea of the voltage producing a spark of great length can be obtained from measurements made with a short one. Again, the length of spark corresponding to any given potential difference will depend upon the nature of the dielectric filling the space through which the discharge is passing.



Spark Voltages for Ball Gap. Balls Used 2 Cm. (13-16ths Inch) in Diameter.

The accompanying curve, based on data given in Dr. J. A. Fleming's "Radiotelegraphy," will be found to be a reliable and useful one for reference by the average experimenter. The ordinates or vertical distances are the spark voltages which were measured for discharges between polished metal balls 2 cm. in diameter, in air, at 760 mm. barometric pressure, and hence are only really accurate for the same conditons. However, they give the potential approximately for any discharge between metal balls in air through the range covered.

A brief study of this curve will show that for spark lengths up to 50 millimeters, or 2 inches, the potential increase with increasing length is not at all constant. As suggested above, some radiations have a marked effect on the spark length possible with a given potential difference. It is an easy matter to show that sparks will pass much more easily than normally if the gap, and in particular the negative ball, is illuminated by ultra-violet light, such as that from an electric arc light, or contained in ordinary sunlight. The same effect will result if the gap or negative ball is heated When, in any experimental work, including radiotelegraphy, small quantities of electricity are discharged across a gap, the best results will be obtained with highly polished balls of zinc or brass, and if the spark is in the open air the accompanying curve will afford a reliable means of determining the potential difference for distances up to 5 centimeters, the distances being taken between the nearest points on the two balls.

Contributed by E. H. JOHNSON.

Wireless Relays and Amplifiers

APPARATUS falling under this category are of paramount importance to all wireless workers, amateur and professional alike. We all realize that if we employ a proper relay, then with a given amount of energy much greater distances can be transmitted over, other things being equal, than if the relay is not used. Relays sufficiently sensitive for radio receiver circuits are now made and applied commercially in several different styles. The principal types now prominent or feasible are the Lieben-Reiss and DeForest gas or ionic stream valves, the Brown electromagnetic relays, the Telefunken multiple stage tuned microphone relay, and the Parsons compressed air amplifier. There are several other types on the market, but the above represent the principal basic types so far developed, excepting the Fessenden heterodyne.

The DeForest audion detector and amplifier is already familiar to most readers, and full description of his amplifier, with two and three audions in cascade, was given by this journal some time ago.

The newer gas or ionic stream relay of Lieben and Reisz, the German investigators, is similar to the audion, but possesses distinctive features of its own which render it particularly efficient as an amplifier for weak radio currents, which vary from 1 to 50 micro-amperes usually for fair signals. Their gas relay is shown diagrammatically in Fig. 1. Here a regular radio receiving circuit is represented with aerial A, ground G, coupling transformer L C, detector D of the mineral type, variable condenser V C, and a special transformer T_1. The primary of transformer T_1 takes the place of the telephone receivers usually employed. The secondary of the transformer acts on the valve tube shown at A H K.

The glass tube is exhausted of air and filled with attenuated vapor of mercury at a pressure of 0.001 mm. (20°C.), and this vapor rises from a small portion of mercury amalgam placed at the bottom of the tube. The cathode electrode at K is a platinum strip 1 mm. wide, 0.5 mm. thick and 1 meter long wound on a glass supporting stem, zigzag fashion. This strip is coated also with a thin layer of barium and calcium oxides. The anode electrode A consists of an aluminum wire spiral, while the auxiliary electrode H is made of a thin aluminum plate extending across the tube inside, between anode and cathode. It is punctured through with many holes about 3½ mm. in diameter.

Also, in general, the cathode K is brought to a bright red heat by an electric current from the potentiometer R, attached to a 30-volt battery. Across the cathode and anode is impressed 220 volts D. C. from a dynamo, etc. The voltages must be kept quite steady. A high resistance W, shunted by a condenser C, is in series with the anode, as also the primary coil of a transformer (step-up) T_2. The secondary S connects with telephone receivers P.

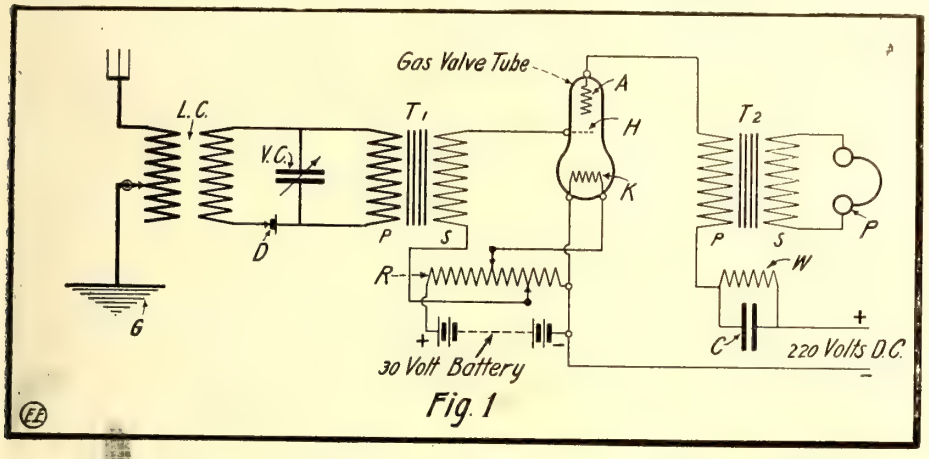


Fig. 1. Circuit and Arrangement of the "Lieben-Reisz" Gas Relay or Amplifier.

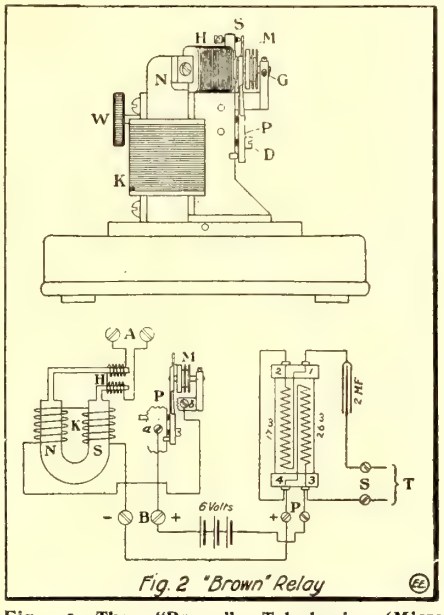


Fig. 2. The "Brown" Telephonic (Microphonic) Type of Relay Adaptable to Radio Circuits.

It was discovered by Wehnelt that heated metallic oxides emit electrons; so in the Lieben-Reisz relay the heated cathode K gives off a stream o cathode rays or electrons (cathions), which pass through the holes in the grid H connected to the radio circuit through transformer T_1. The strength of the cathion discharge through H will depend on the potential of H. Hence it will be seen that varying grid (H) potentials are constantly produced by the received hertzian wave signals acting through the circuit and transformer T_1. As the cathode stream is varied, so will the 220-volt current vary in proportion, and these variations will be heard as strong signals in phones P.

This valve tube acts therefore as a true relay, and it is said that one tube, as here shown, boosts the received currents to 33 times their original amplitude. Of course two or more tubes can be connected in circuit to give any amplification desired.

The electro-magnetic telephone and telegraph relay made by Brown, of England, is widely used for telephone current intensifying, and has been considerably employed for boosting radio signals.

Its make-up will be gleaned from Fig. 2 where N S is a permanent steel magnet frame surmounted by two magnetizing coils K, and two 4,400-ohm coils H (same size pole-pieces, etc., as used in receiver). A light spring or reed P carries a soft iron head to be attracted by the pole pieces. Attached to the moving reed is a rod joined to a delicate microphone M filled with carbon grains.

Referring to the diagram of connections in radio circuits we see that terminals A are joined in place of the regular telephones. The magnet coils K are energized by current from a battery of six volts through the primary (17 ohms) of an auto transformer P S. Across the transformer secondary (26 ohms) at 3, 1, is connected a 2 M. F. condenser in series with a pair of 120-ohm telephone receivers. Its action will be understod readily now. The varying hertzian currents react through coils H on the relay magnetic circuit balance, and cause its armature reed P and the microphone M to vary their positions. The microphone thus changes the resistance of the circuit, and these are transmitted through the transformer P S and condenser to the head telephones.

This style "G" Brown relay has an intensifying figure of about 20 times received strength of signal. Newer types can intensify 100 times and more, or several may be joined in cascade to give as high a ratio as required.

The Telefunken Co. utilizes a unique amplifier indeed, which is outlined at Fig. 3.

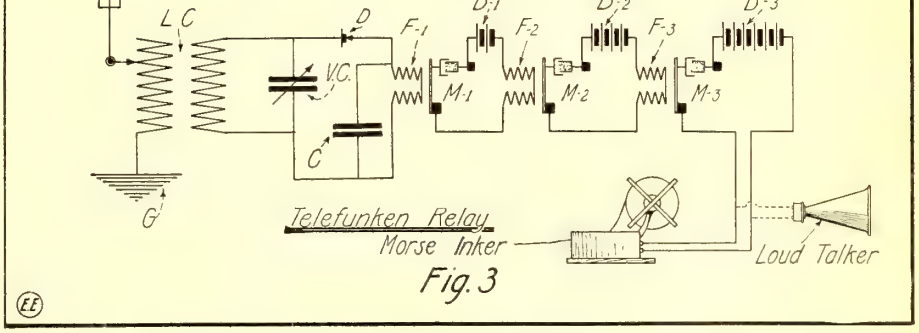


Fig. 3. The "Telefunken" Amplifier Scheme For Radio Receptors, Using Several Tuned Microphones in Cascade.

A radio coupling circuit is joined to a "tuned" reed microphone relay F_1 M_1, and

this reacts or controls the battery through a second "tuned" reed microphone M_2, etc., etc. Three microphones are commonly used. Two of these "tuned" amplifiers can receive two distinct messages on an aerial simultaneously without interference, if they and the incoming waves have a tune frequency differing by 20 per cent. or over. Such microphonic apparatus is extremely delicate and must be very carefully adjusted and supported on elastic bands, etc. The third microphone circuit can control a loud talker or Morse tape recorder as desired.

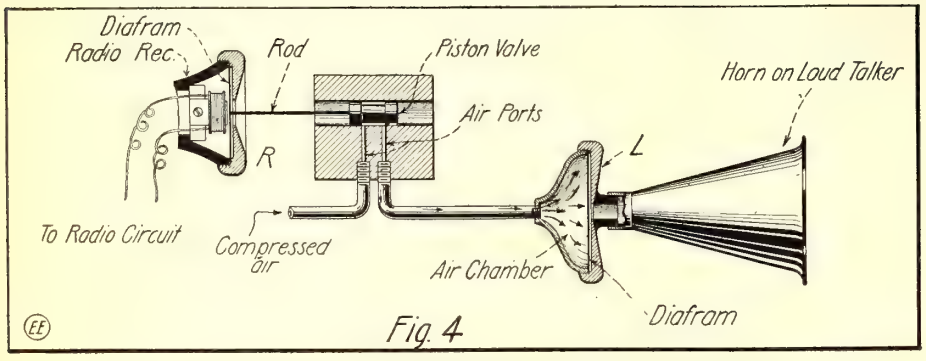


Fig. 4.—The Latest Form of Radio Amplifier Employing Compressed Air.

A new and extremely simple form of intensifier for telephone or telegraph signals is the Parsons compressed air valve, depicted at Fig. 4. A radio or telephone receiver R is connected with by a rod, as seen, to a piston or other valve. Whenever the receiver diaphragm moves or signals are received, it actuates or moves also the air valve controlling the flow of compressed air to a loud talking diaphragm chamber L, and horn as shown. This is only a rough description of this interesting device, which is now being adapted to high grade talking machines to boost the strength of the reproduced voice.

A TUNING COIL WRINKLE.

The wire on a home-made tuning coil is apt to become loose, owing to expansion and the raking effect of the slider. Here is a way to prevent it. First cover your cardboard or wooden core with adhesive electric tape, winding it on spirally and not allowing the edges to overlap. Wind your wire over this tape and it sinks in slightly, forming a groove or screw-thread for itself, so that even when the tape becomes hard, as it will do in time, the wire will not become loose.

Contributed by T. REED.

GOVERNMENT OPENS NEW DARIEN RADIO STATION.

The powerful radio-telegraphic station situated at Darien, in the Panama Canal Zone, has been recently opened for regular service by the U. S. Government.

This station is equipped with a large size Poulsen arc generator and is rated with a transmitting and receiving radius of 4,000 miles.

On the opening test radio-communication was effected between Arlington and Darien, which is a distance of 2,000 miles. There was much criticism at the time the equipment for this station was selected by the Government radio experts, because of the arc transmitter which was favored.

However, as Capt. Bullard has pointed out, the Poulsen arc has certainly proven its wonderful efficiency under the long distance conditions, especially in view of the fact that it has been in daily use for a considerable period at the Tuckerton, N. J., radio station for transmitting day and night wireless messages over a distance of 4,000 miles to Germany.

CONTROLLING 2 K.W. WITH COMMON MICROPHONE.

At one of the Spring meetings of the Institute of Radio Engineers, Dr. Irving Langmuir gave a remarkable paper on the "Electron Discharge in High Vacuum Tubes."

These wonderful tubes, having principally tungsten or molybdenum elements as electrodes, were described in the form of high-voltage rectifiers, high-frequency oscillation generators and radio detectors. Different entirely from the gaseous Audion, they have enormously high vacuums (as low as two 10-millionths of an atmosphere), and the electrodes of tungsten are specially treated so as not to give out when heated, any occluded gases whatever, i. e., gases held in the metals by absorption ordinarily. Hence these tubes always give similar results and are under perfect control, the same as the new Coolidge X-ray tube, as they are absolutely (practically) gas free.

Dr. Langmuir described two radio-telephone transmitters of this type used at the General Electric Works, the smaller set with pliatron tube developing 1½ amperes in the antenna and transmitting speech wirelessly from Schenectady to Pittsfield, Mass. Wonderful amplifying powers were also obtained in radio receiving, eclipsing the performance of Audions. He stated that a common microphone easily controlled 2 K. W. through one of these tubes, giving perfect control for radio-telephony. Several tubes can be joined on multiple to give more power when required.

AN IMPROVED ELECTROLYTIC DETECTOR.

The following detector will almost double the strength of the signals received. To construct it plane up a board 4 inches square for the base. From a piece of round, hard carbon cut a piece 1 inch long. Bore a hole ⅜ inch in diameter ½ inch deep on the top side. On the bottom end bore a hole ⅜ inch in diameter and ¼ inch deep. Pour the latter hole full of molten lead. Drill and tap a hole to fit a 3/16-inch machine screw in the lead. One-quarter inch from the top bore two 3/16-inch holes opposite each other. Put a platinum wire in each so that it will project a slight distance in the cup. Fasten them temporarily in place by filling the cup with clay. In the 3/16-inch holes pour molten lead, thus sealing the platinum in the walls. Remove the clay.

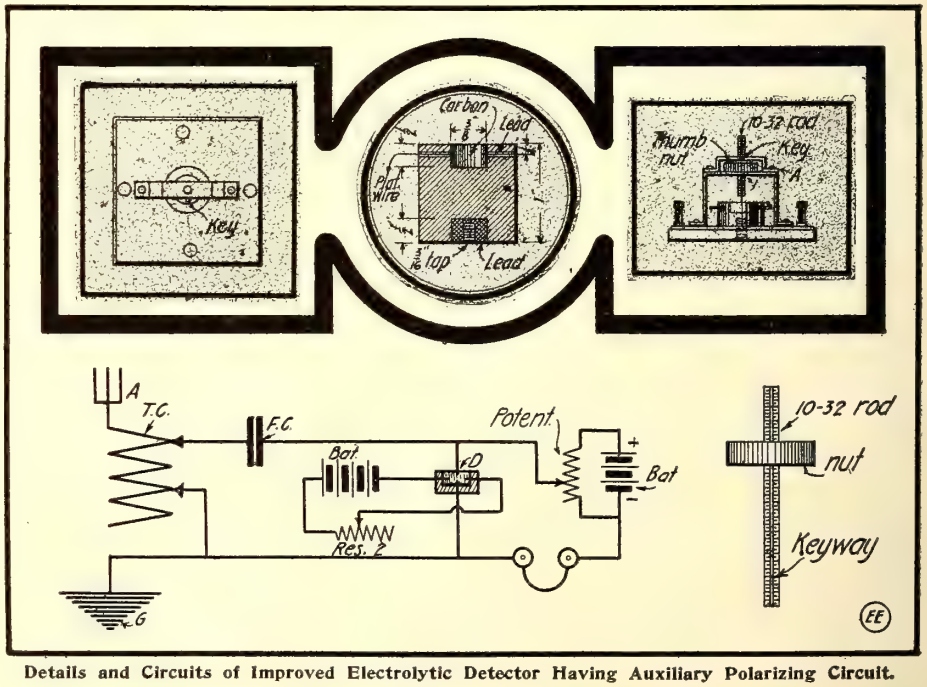
For the standard to support the thumb screw obtain a piece of brass ¾ inch wide by ⅛ inch thick and form it as shown in sketch. Drill a hole to pass No. 10-32 thread at the place marked 1 and on top of the standard solder a piece of brass as indicated at A. Drill hole in line with the other hole and of the same dimensions.

Thread a brass rod with No. 10-32 thread and about 2 inches long. Procure a nut to fit the thread. With a 3-cornered file make a small groove in the rod. On top of the standard solder a pin or key projecting slightly into the hole. This should be adjusted so the rod will slide up and down, but so it cannot turn. Solder a piece of Wollaston wire to the rod at the lower end.

To assemble fasten the cup to the center of the base. Fasten the standard in place. Slip the head in the slot, first having forced the nut in the head. Then screw in the rod. Adjust the rod the same as in an ordinary electrolytic detector. The action is as follows: When the platinum is connected with batteries it causes electrolysis, thereby augmenting the breaking of the film of gas surrounding the bare point. Resistance 2 should be high, or variable, from 50 to 150 ohms, etc.

Note that the two platinum wires entering the carbon cup must, of course, be well insulated from the carbon.

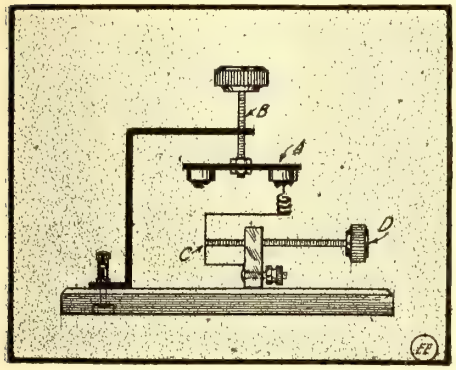
Contributed by ISAIAH ROSIN.



Details and Circuits of Improved Electrolytic Detector Having Auxiliary Polarizing Circuit.

RADICAL DUST-PROOF DESIGN FOR DETECTOR.

As is well known, radio detectors of the mineral type rapidly lose their sensitiveness when the minerals become covered with dust. A great many, of course, endeavor



Radical "Dust-proof" Detector.

to overcome this trouble by covering the detector with a glass bell or by other means.

A new scheme is shown herewith which should prove efficient, and as per sketch the mineral cups are placed on a brass bar or disc A supported by an adjustable threaded rod B. A "cat-whisker" wire contact point of the usual type may be placed on a brass spring C, which has its tension adjustable by means of a threaded rod and knob D.

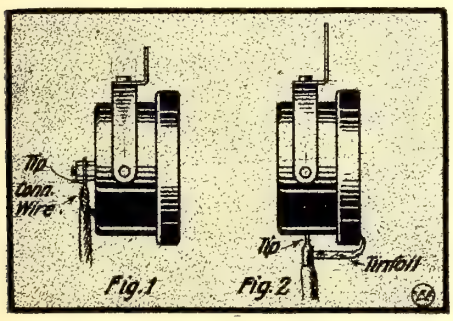
At first this may seem quite impracticable, but on second thought you will see that this is just as easy to adjust as if the mineral cups were facing upward, as in most detectors. This is because you cannot (naturally) "see" the sensitive spot on the mineral, and it must be found, of course, by placing the "cat-whisker" contact point on the various parts of same until the most sensitive spot is ascertained, as manifested by the loudest buzzer-test signal *heard* in the telephone receivers.

Contributed by CARL HENLEIN.

ANTI-HUM STUNT FOR RADIO RECEIVERS.

A great many amateurs are troubled by humming in the wireless receivers due to induction from neighboring electric light wires. The following directions will, if carried out, nearly always eliminate the said hum:

The first method, applying to receivers with metal shells and headbands (not covered with rubber or other insulating compound), consists of merely connecting the tip with copper wire to the shell of the re-



Anti-Hum Prevention in Wireless 'Phones.

ceiver or headband as shown in Fig. 1.

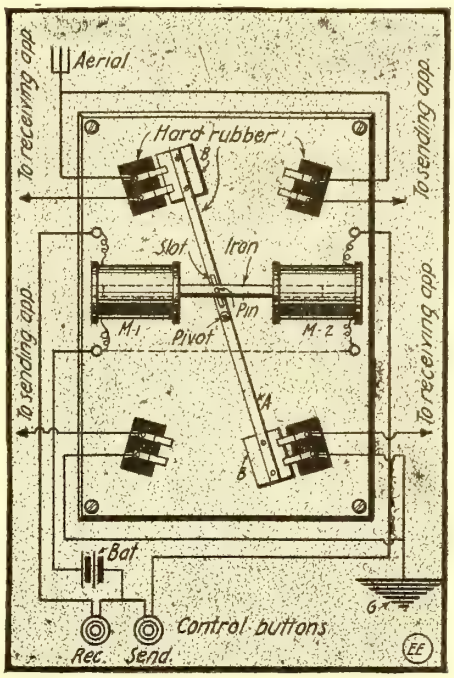
In instances where the receivers and headbands are covered with rubber or other insulating compound it is necessary to wrap a strip of tinfoil around the tip and then paste it down. Then bring it across and paste it there in such a way that it will touch the ear when the receivers are on the head. This will allow the induced current to pass through the body (see Fig. 2).

Contributed by URBAN McMILLER.

A MAGNETIC CONTROL AERIAL SWITCH.

As most wireless experimenters do not care to have the old style aerial switch on their table, etc., with which to control the aerial and ground connections from transmitting to receiving apparatus, etc., the idea here incorporated will undoubtedly appeal to them. On a wax-impregnated hardwood panel about 1 foot square, or better, a piece of marble, is mounted by means of a central pivot a fiber or hard rubber arm A. This arm may be about ¼ by ½-inch stock and 7 to 8 inches long. It carries at either end a contact plate BB of about 1/16-inch copper or brass, having their edges tapered down so that they will readily slip under the sets of contact springs C C C, etc.

These contact springs may be made of phosphor bronze or brass and of about 1/32 by ½-inch stock, mounting the springs CC about 1½ inches apart on hard rubber blocks as indicated in drawings. The connections to this switch will be readily understood by looking closely at the diagram. The pivoted arm is moved from right to



Magnetically Operated Aerial Switch.

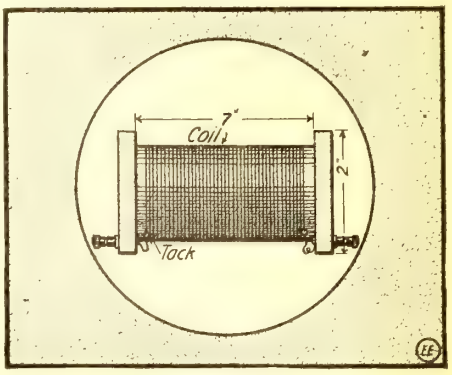
left by means of an iron armature. This armature carries a pin which moves in a slot in the fiber arm A. Two solenoid type electro-magnets M1 and M2 serve to pull the iron armature to the right or left, accordingly as the "control" push buttons are depressed.

The electro-magnets M1 and M2 should consist of brass tubes about ⅜ inside diameter and 3 inches long. They may be wound with about 14 to 16 layers of No. 20 insulated magnet wire. A battery as shown supplies current for this magnetic control circuit arrangement. If properly constructed and by using 6 to 8 dry cells for the battery, etc., this switch will prove a very efficient and attractive addition to any radio station, and it may be placed in a small box with glass front on it; or it may be placed under the operating table, as the builder and user may elect. Contributed by

J. MILTON CRANDALL.

BUZZER-TEST RESONATOR.

I have been using an arrangement called a resonator in my wireless-receiving buzzer circuit. It is such a great help that I thought I would send you the description to publish in *The Electrical Experimenter.*



Buzzer Test Amplifying Inductance.

It is very simple. First, get a 7-inch piece of wood, well seasoned and about 1½ inches in diameter. Shellac or varnish this well. Now wind No. 26 enameled wire on this core for about 6 inches. Fasten the ends of the wires by driving in a tack or short nail at each end, and wind the wire around it a few times. The coil can then be mounted on two square pieces of varnished hardwood, which will increase the looks of the apparatus. The coil is connected in series with the regular buzzer-test wire, which leads to the detector. I find that it makes adjustment 50 per cent. easier, especially with the Crystaloi detector. Contributed by

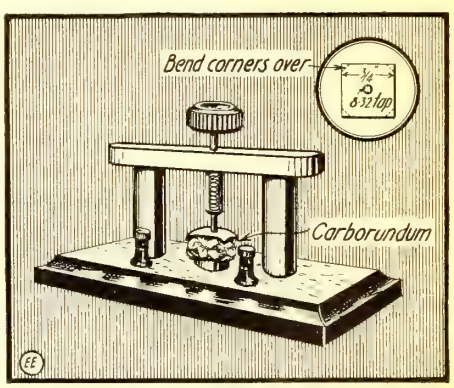
DONALD B. ROCKWELL.

A CHEAP BUT EFFICIENT CARBORUNDUM DETECTOR.

It will be necessary to purchase one Adjustable Zinc spark gap to make this detector.

Remove the two zinc points and substitute two pieces brass, ¾" square and 1/16" thick, bending over the four corners as per diagram on both pieces. Put a hole in the center of each, and thread for an 8/32 screw. Screw the pieces on the small threaded ends left after removing the zinc points and file off the ends that protrude thru the brass squares. Purchase a piece of carborundum and place it between the brass points, then tighten down the hard rubber knob.

The detector is now ready for use. One



Carborundum Detector Made from Spark Gap.

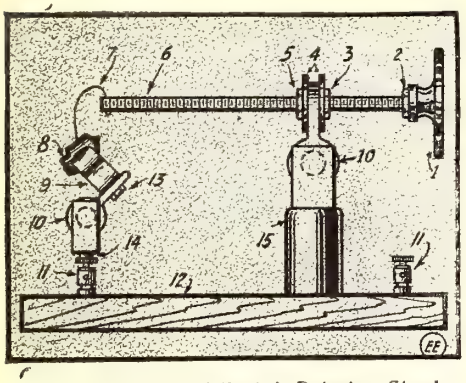
of the characteristics is that when you tighten the thumb screw, the brass points do not move out of alignment.

Submitted by H. J. ANDREWS.

CLEVER MINERAL DETECTOR.

The materials needed for the construction of this detector are as follows:

Wooden or hard-hubber base 5 inches long, 2½ inches wide and ⅜ inch thick



Ball and Socket Adjusted Detector Stand.

(No. 12, referring to diagram); spark-plug ball and socket connector with hard-rubber base (10 and 15); spark-plug ball and socket connector with short brass base (10 and 14); threaded brass rod ⅛ inch in diameter by 3 inches long (6); telegraph key knob (1); clip off small fuse block (9); four binding posts (11, 11); two small washers (4); three small nuts to fit threaded rod (2, 3 and 5); small bolt and nut (13); also two thin bolts to hold uprights to base (not shown in drawing). The four binding posts are mounted, two in front and two in the back, the wire connections being made from the back one on the right-hand side in the drawing to the front one; then to the bolt which holds upright in place, making contact with brass part of ball and socket joint, the same being done on the other side. Connect the 'phones to the front binding posts. Aerial and ground to the other two.

The "cat whisker" is made fast by passing one end of it through a small hole which is drilled in the brass rod, making the wire fast by soldering it in place. By unscrewing the two nuts (3 and 5) you may move the rod to any desired position.

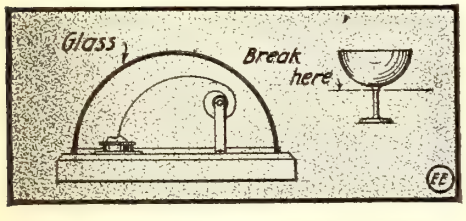
The spark-plug ball and socket connectors are made by the Connecticut Co., and may be obtained in any auto-supply store. Contributed by

WILLIAM DAVIS HAWK.

DUSTLESS DETECTORS.

Dust gathering on detector crystals necessitates repeated washings if best results are desired, and a good plan for keeping the dust out, still allowing observation, is shown in the sketch.

A wine glass, preferably of thin stock, has its stem broken off as near the bowl



Glass Goblet Serves to Protect Detectors from Dust.

as is safe and the rest of the stem is carefully ground off on an emery wheel or grindstone until the bowl has a smooth appearance. It may then be smoothed up on an oil stone. The dimensions of the detector itself must conform with the inside of the glass, and for that reason no dimensions are here given. Contributed by

FRED'K J. SCHLINK.

MAKING TUBES FOR TUNING COILS.

Here is an easy way to construct a very serviceable tube. The tube's great advantage is its lightness.

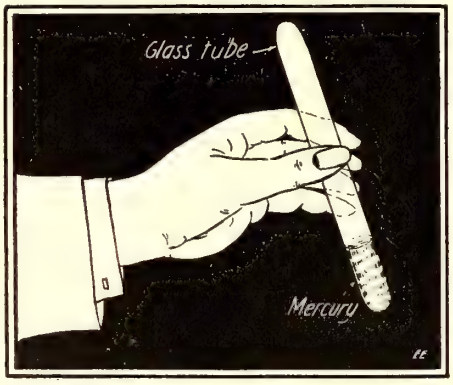
Take a strip of cardboard several feet long and a foot wide. The width may, of course, be varied if a longer or shorter core is desired. Put the piece of cardboard to soak in water till it is very soft and limp.

Next take a rolling pin or some other cylindrical object and wind the wet cardboard on the cylinder, glueing or shellacking one layer of cardboard to another. When you have wound on enough cardboard to give you the thickness you want, bind the cardboard with heavy string and put the bundle into a warm oven. In a few hours take the pin out, and the cardboard when taken off will be so stiff that you may easily wind it with wire of almost any size. NORMAN HALL.

A SELF-EXCITING GEISSLER TUBE.

When the mercury in a barometer tube is agitated the friction of the mercury on the glass generates electricity and produces effects which are visible in the dark.

The self-exciting vacuum tube herewith shown operates in the same manner. The electrical effect is produced by the friction



Geissler Tube Using Mercury Only, and No Current.

of mercury on the inner surface of the glass vacuum tube as the tube is inverted or shaken. The full effect is realized only when the mercury is allowed to flow quickly from one end of the tube to the other, but any agitation of mercury in the tube produces some phosphorescent light. This principle is utilized as an auxiliary signal in bell buoys and whistling buoys.

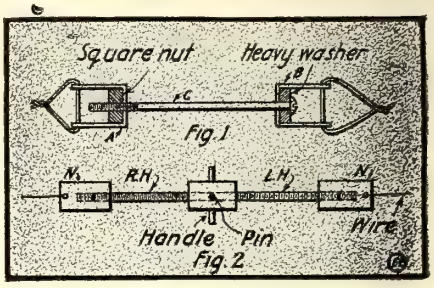
GERMANS' TREBLE WIRELESS PLANT.

The big Telefunken wireless station at Sayville, L. I., the plant through which the German Government transmits most of its official communications to the United States, and through which the German Embassy communicates with Berlin, has been quietly, almost over night, so to speak, increased from a 35 K. W. plant into one of 100 K. W. Three 500-foot towers have been added to the aerial system.

The transformation of the Sayville plant into one of the most powerful of the transatlantic communicating stations in this part of the world has been carried on so quietly that very few persons outside of the radio officials of the Department of Commerce and a few naval officials connected with the wireless naval service have known what was being done. The new and larger equipment was shipped from Germany via Rotterdam.

A CHEAP TURNBUCKLE.

The accompanying diagram (Fig. 1) shows a turnbuckle which can be readily made by everyone. The pieces A and B are of strip brass or iron about ⅛ inch thick and about ½ inch wide. At C is an iron bolt about 3 inches long with a round



Simple Form of Turnbuckle.

head. The turnbuckle is readily tightened with a screwdriver.

At sketch (Fig. 2) is depicted another easily made and serviceable type of strain turnbuckle. It is made of preferably nothing smaller than a No. 14-20 threaded steel rod, one-half the rod being threaded left-handed and the other half right-handed. The steel nuts N N are threaded right-handed and left-handed accordingly, and when the center handle, which is pinned to the threaded rod, is revolved by hand it causes the nuts N ... to recede or approach each other.

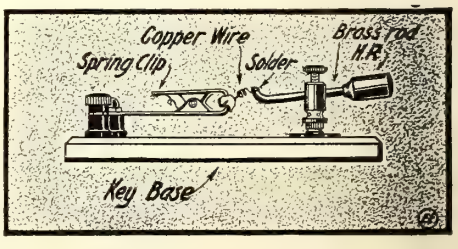
AN ALLOY FOR RADIO CRYSTALS.

Dissolve as much tinfoil (not lead foil) as possible in 5 cents worth of mercury or quicksilver. Work this mass with the fingers until no more tinfoil can be used. Place the mass in a small cup and hold the cup over an alcohol flame with a pair of pliers until the mixture melts. Pour it onto a paper and let it cool. It may then be broken into pieces and kept indefinitely. This alloy melts easily and the crystals can be mounted in it. It is quite hard when cold.—Contributed by

LLOYD STRATTON.

A SIMPLE GALENA DETECTOR.

The following is a description of a galena detector which I have made and found to be very sensitive. The base was from a telegraph strap key. The key lever was taken off and a helix clip cut off and drilled and put in its place. The contact screw was then removed and a binding post put in its place, under which was placed a battery burr, which served to



Effective Galena Detector.

raise the binding post, and also acted as a lock nut so that the binding post could turn. A small brass rod was placed through the binding post and on one end was mounted a suitable hard rubber handle and to the other end was soldered a coiled piece of copper wire, also the rod was bent as shown in the drawing.

Contributed by HAROLD PRUDEN.

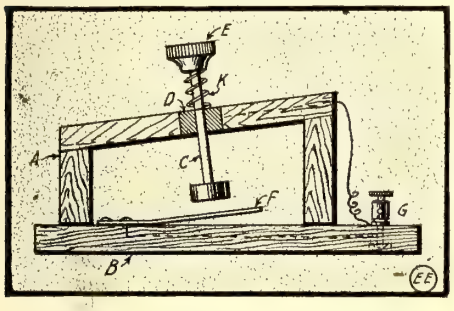
HOW-TO-MAKE-IT DEPARTMENT

This department will award the following monthly prices: FIRST PRIZE $3.00; SECOND PRIZE $2.00; THIRD PRIZE, $1.00.
The idea of this department is to accomplish new things with old apparatus or old material, and for the most useful, practical and original idea submitted to the Editors of this department, a monthly series of prizes will be awarded. For the best ideas submitted a prize of $3.00 will be given; for the second best idea a $2.00 prize, and for the third best a prize of $1.00. The article need not be very elaborate, and rough sketches are sufficient. We will make the mechanical drawings.

FIRST PRIZE $3.00.

FOOT-OPERATED PUSH-BUTTON FOR TEST BUZZER.

It is often found inconvenient when adjusting a crystal detector such as that of the galena type to push with one hand the button or switch controlling the buzzer circuit. In order to allow the freedom of



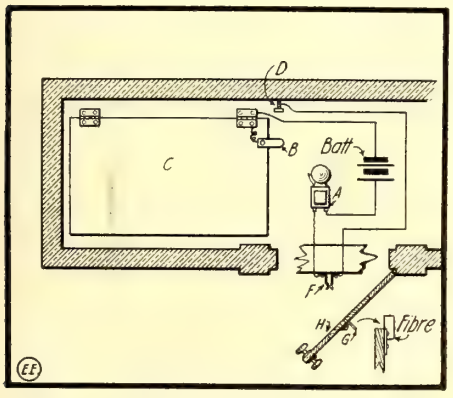
Useful Foot Switch for Buzzer Test, etc.

both hands for adjusting the apparatus yet enable one to operate the buzzer when desired, a switch arrangement that may be operated by the pressure of the foot is illustrated in the accompanying drawing. This device consists of a wooden block A, measuring 2 by 1⅛ by 2 inches; another block B, measuring 2½ by ¼ by 2 inches, which is used for the base; a metal pin C, which is threaded at one end and fitted with the composition knob E; a spring on the pin C shown at K; a metal strip F and the binding posts G. The construction of the push-button can readily be followed by studying the drawing.

Contributed by
THEODORE GATHMANN.

OPEN DOOR BELL ALARM.

Below is a sketch of a device which I think a number of the readers of the *Electrical Experimenter* would be interested in. In my house one of our cellar doors is in the pantry, as illustrated. By carelessness or forgetfulness the cellar door was left open three times, each time a person falling into the cellar. This is what brought about my idea of this little device of *safety first*.



Alarm Bell Rings If Cellar Door Is Open When Pantry Door Is Opened.

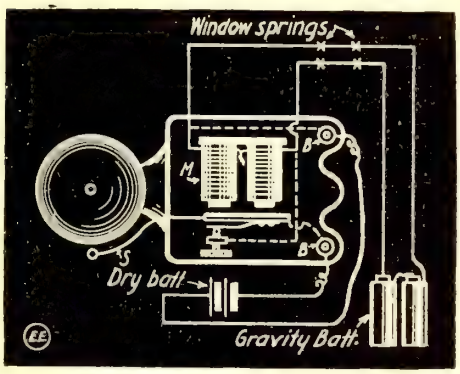
Here is how it works: When the cellar door C is left open spring B comes in contact with the nail D, thus connecting that end of the line. When the pantry door H is opened, the knife G passes between the contact spring points at F, thus completing the circuit and ringing the bell A. This gives ample warning of the danger.

Contributed by A READER.

SECOND PRIZE $2.00.

CLOSED CIRCUIT BURGLAR ALARM.

Given two dry cells, two gravity cells, some wire and the necessary tools; connect the two wires from the gravity battery to the magnets (marked "M" in the drawing). Connect the wire from the dry battery to the regular binding post of the bell. When the gravity cell circuit is broken it allows the striker "S" to rebound and touch the contact screw of the bell, which starts it vibrating in the usual manner. I have found this very efficient and at the same time the cheapest and simplest closed circuit burglar alarm on the market.

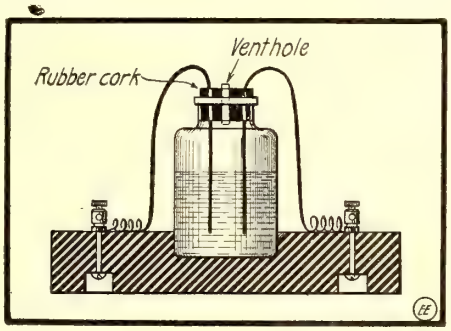


Simple Closed Circuit Burglar Alarm.

Contributed by L. A. MADISON.

A HANDY POLARITY INDICATOR.

Mount a bottle in a block of wood as the cut shows. Arrange two copper wires to dip in the solution of salt water or water to which a slight amount of sulphuric acid has been added. Mount two binding posts on the wood block. When current is connected to the binding posts



Handy Polarity Indicator.

the negative wire will indicate itself by the greater formation of gas bubbles around it. Contributed by
CHARLES ROSENTHAL.

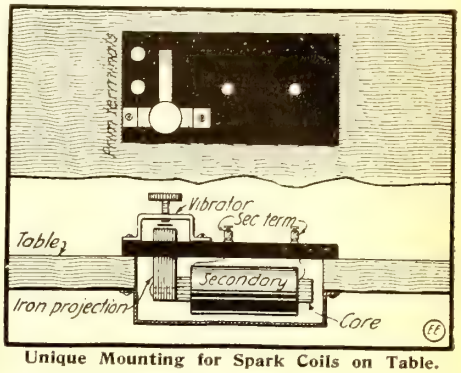
INSTRUMENT LACQUER.

A very good lacquer can be made by dissolving some alum in banana oil. With a small brush paint over the instrument with laquer and let it dry thoroughly before handling.

THIRD PRIZE $1.00.

A NEAT ARRANGEMENT FOR SPARK COILS.

The articles required for this piece of apparatus are a spark coil (any size), with vibrator and binding posts, and a piece of hard rubber about 1 inch longer than the



Unique Mounting for Spark Coils on Table.

core of the coil and 3 or 4 inches wide and ¼ inch thick.

The coil is taken from its case, together with the vibrator and binding posts, and to one end of the core is fastened by means of a nail a piece of laminated sheet iron core, so as to project at right angles; it is cut off at the proper length to work the vibrator, as shown in sketch.

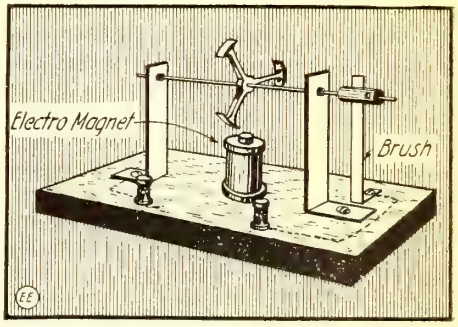
The rest may be best understood from the drawing. The coil itself is put under the table, in oil if desired, and the hard rubber is mounted on the top of the table.

This gives a finished appearance to the instrument very desirable in well arranged radio plants.

Contributed by W. F. ALLSTON.

UNIQUE BATTERY MOTOR.

A short while ago I made a little motor as shown in the illustration. The armature was a three-pole one from an old motor and had the windings taken off. I mounted the axle on which the armature and commutator were fixed between two metal uprights, and under the armature put an electro-magnet from an old bell. The brush was adjusted so that the little screw on the commutator just hit it. To



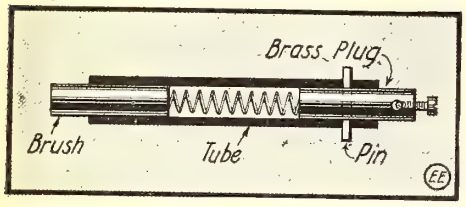
Simple Electric Motor Having But One Electro-magnet.

make the other connection to the commutator I put some small pieces of wire in the screw holes so that they pressed against the shaft.

The current coming from the battery passes through the electro-magnet, upright, axle, commutator, the brush and then back to the battery. JOHN B. MOORE.

BRUSH HOLDERS FOR SMALL MOTORS.

The illustration below shows how very efficient brush holders for small electric motors are made. To begin with, a small piece of fiber or hard rubber tubing is procured and a round carbon brush slides inside the tube; pressure being exerted behind the brush by a spiral spring, as perceived.



Easily Made Brush Holders for Small Motors.

Contact is made from the brush through the spring on to a brass terminal connecting plug, as indicated.

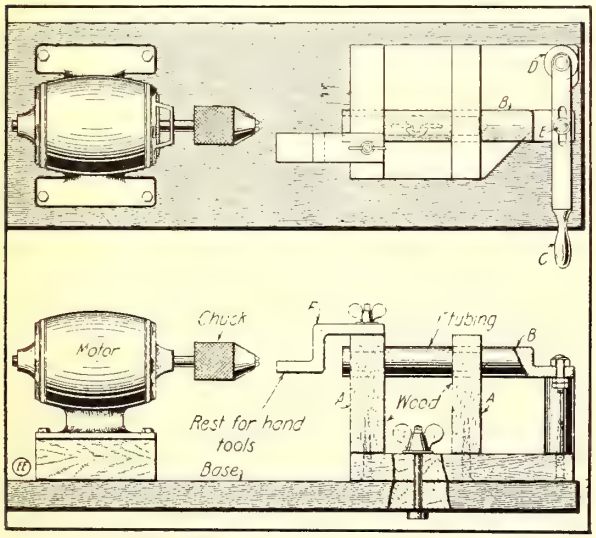
When the brush holder tube is clamped in the machine against the commutator there should be about ⅛ inch or less space between the end of the insulated tube or *brush holder* and the commutator.

To remove the brushes for renewals, etc., when the machine is assembled and when it is not desirable to remove the whole brush holder for the purpose, the brass terminal plug is easily removed by taking out the brass pin shown. The spring pressure exerted between the terminal plug and the brush will always hold the pin in place, but in some cases a small cotter pin is utilized, so that it will not work out, due to vibration.

HANDY ATTACHMENT FOR DRILLING WITH ELECTRIC MOTOR.

Those having a small electric motor at hand can very easily rig up a handy drilling or boring attachment, as shown in the illustration herewith.

The motor is simply mounted on a hard wood or iron base and the shaft is threaded to hold a small drill chuck, which can be purchased at any machine or supply house at small cost.



Drilling, Boring and Turning Attachment for Small Motors.

At the other end of the base is arranged a hard wood or iron frame having two uprights on it at AA. These are drilled so as to pass around a sliding bar B. This bar is moved back and forth by handle C pivoted at D, and by a slot at E in which a pin fastened on the sliding bar B travels, as it is moved back and forth.

To those desiring to use hand turning tools, etc., a simple brass or iron support F will prove useful. This is held by a heavy machine screw wing-nut, as perceived, so that it may be swung out of the way when not in use. The sliding bar B is used to press the work against the drill, similar to drilling in a lathe, and in fact a very good lathe for light work can be made in this way by placing a conical *center* in the spindle B and gripping the work in the chuck, or a second center may be formed on the end of the motor shaft and the work held by a "dog" clamp arrangement. A speed controller is best used in series with the motor, thus giving a wide range of usefulness to this idea.

Contributed by E. L. H.

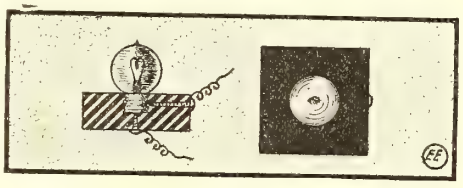
STATIC MACHINE PLATES.

Many experimenters who wish to build a Wimshurst static machine find it difficult to obtain the necessary plates. Phonograph plates are very suitable for this purpose. Use records that have a song on one side. The tinfoil sectors can be mounted on the smooth side of the record plate with thin shellac, glue or beeswax.

Contributed by S. C. A.

MAKING SMALL LAMP SOCKETS.

The sketch presented is a socket for a miniature candelabra, or single point Edi-



Lamp Socket Made from Fiber, etc., and 2 Screws.

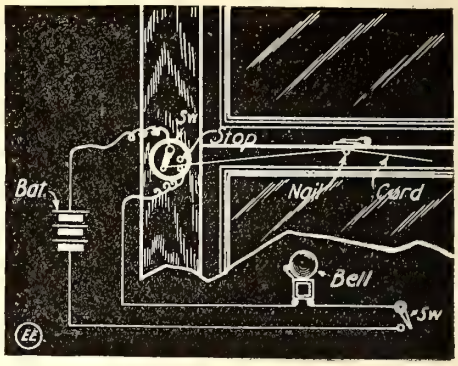
swan base lamp. It is very simple. The drawing, I think, will explain it all.

Contributed by ROBERT McCREADY.

Arc Lamp: An antediluvian lamp which archæologists agree was invented by Noah and used on his hydroplane "The Ark" (from which it takes its name) before the new lighting regulations were enforced.

A NOVEL WINDOW BURGLAR ALARM.

Articles: Two switches (as shown), three cells of battery, some wire, a common hook. It does not require a long description, as the sketch clearly explains itself. Fasten switch on one side of window, as shown. Screw in your hook right under the sash lock of your window. Fasten bell and switch for same at some convenient place in another room. The idea of this arrangement is as follows: Suppose you set the alarm. You fasten a fine silk thread, or cotton string, from the handle of the switch, string it through the hook you have screwed right under the lock of window and tighten it on another small tack on the right hand side of the window. The intruder comes along, gently lifts the window, the gentle raising slowly moves the handle of the switch to the right (see sketch) to the switch point. A little tack in the switch prevents the handle of the switch from moving further. The burglar keeps on lifting. The thin silk string is broken by the pressure and the circuit between the alarm bell in your room is closed until you throw back your switch.



Burglar Alarm Using String to Close Switch.

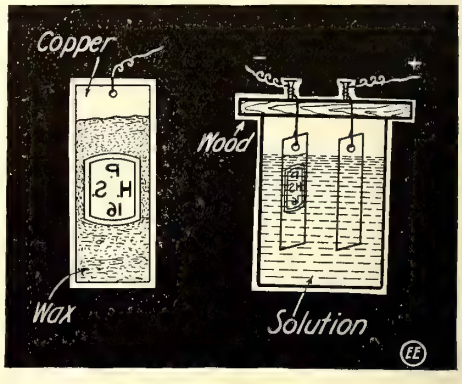
It is a very simple and reliable burglar alarm. If properly adjusted no sneak or burglar can enter your dwelling.

Contributed by JAMES PEABODY.

MAKING SMALL ELECTROTYPES.

This small electrotype is a model of the way all the cuts for printing books are made. First procure at a drug store two ounces of blue vitriol and an ounce of graphite. Also procure two copper strips 6 inches by 1½ inch, preferably with wires soldered to them, and some beeswax or paraffin.

A pint fruit jar should be filled about two-thirds full of water and the two ounces of blue vitriol placed in it and stirred until water is blue. Then one of the copper strips should be covered with the beeswax or paraffin over a little larger space than the impression is to be. The wax should then be rubbed with the powdered graphite until shiny, care being taken to get graphite around the edges. The impression should then be made by placing the letters, etc., backwards. The wax should then be dusted with the graphite so the impressions will be covered. Then all parts of the strip not wanted in the type should be coated with the wax. This strip may then be fastened to the negative or zinc pole of a series of batteries and the plain strip to the positive or carbon pole. Three cells of battery



Making Small Electrotypes.

should be conneced in series to do the plating. The two strips should be placed in the solution about ½ inch apart, so that the impression faces the copper strip. They should be left in the solution about 36 hours, after which the electrotype may be taken from the wax by a thin-bladed knife. If desired, the electrotype may be backed with solder or other metal to make it more substantial. Contributed by

KENNETH SUTTON.

WRINKLES — RECIPES — FORMULAS

Edited by S. GERNSBACK

Under this heading we will publish every month useful information in Mechanics, Electricity and Chemistry. We shall be pleased, of course, to have our readers send us any recipes, formulas, wrinkles, new ideas, etc., useful to the experimenter, which will be duly paid for, upon publication, if acceptable.

FORMULA NO. 12.

Varnishes.

Varnishes (common Oil Varnish).—*Resin,* 4 lbs.; *Beeswax,* ½ lb.; *Boiled Oil,* 1 gal. Mix with heat, then add *Spirits of Turpentine,* 2 quarts.

Chinese Varnish.—Mastic, 2 oz.; *Sandarac,* 2 oz.; *Rectified Spirits,* 1 pt. Close the Matrass with bladder with a pin hole for the escape of vapor; heat to boiling in a sand or water bath, and when dissolved strain through linen.

Mastic Varnish.—Mastic, 1 lb.; *White Wax,* 1 oz.; *Spirits of Turpentine,* 1 gal. Reduce the gum small, then digest it with heat in a close vessel till dissolved.

Turpentine Varnish.—Resin, 1 lb.; *Boiled Oil,* 1 lb. Melt, then add *Turpentine* 2 lbs. Mix well.

Pale Varnish.—Pale African Copal, 1 part; fuse. Then add hot *Pale Oil,* 2 parts. Boil the mixture till it is stringy; then cool a little, and add *Spirits of Turpentine,* 3 parts.

Lacquer Varnish.—A good lacquer is made by coloring *Lac Varnish* with *Turmeric* and *Annatto.* Add as much of these two coloring substances to the varnish as will give the proper color; then squeeze the varnish through a cotton cloth, when it forms lacquer.

Gold Varnish.—Digest *Shellac,* 16 parts; *Gum Sandarac, Mastic,* of each 3 parts; *Crocus,* 1 part; *Gum Gamboge,* 2 parts; all bruised, with *Alcohol,* 144 parts. If yellow is required, use *Turmeric, Aloes, Saffron* or *Gamboge;* for red, use *Annatto* or *Dragon's Blood* to color. *Turmeric, Gamboge* and *Dragon's Blood* generally afford a sufficient range of colors.

Varnish for Tools.—Take *Tallow,* 2 oz.; *Resin,* 1 oz., and melt together. Strain while hot to get rid of specks which are in the resin; apply a slight coat on your tools with a brush, and it will keep off rust for any length of time.

Cabinet-Maker's Varnish.—Very pale *Shellac,* 5 lbs.; *Mastic,* 7 oz.; *Alcohol,* 90 per cent., 5 or 6 pts. Dissolve in the cold with frequent stirring. Used for French polishing, etc.

Waterproof Varnish.—The following is much used for waterproof textile fabrics: Boil together until thoroughly incorporated: 2 qts. *Linseed Oil* and ½ lb. *Flour of Sulphur.* Apply lukewarm.

Electrical Varnish.—The only good varnish for all kinds of electrical work, also for finishing wood and metal work, is formed by dissolving *Orange Shellac* in 95 per cent. *Alcohol.*

Mechanics Varnish.—Mix together: 5 parts of *Rosin,* 1 part of *Dragon's Blood,* 1 part of *Gamboge,* 2 parts of *Gutta Percha,* 1 part of *Shellac,* 40 parts of *Volatile Tar Oil.* S. G.

LINING FOR PLATING TANKS.

In pickling, plating and other metal treating processes the lining for the acid-holding tanks requires certain qualities to resist the corrosive action of the acids. A mixture consisting of 75 parts (by weight) of pitch, 9 parts plaster-of-paris, 9 parts ochre, 15 parts beeswax and 3 parts litharge is said to form an efficient lining for this purpose.

INK RECIPES.

(1) Black Writing Ink.—Take 6 ounces of the best gallnuts and pound them in a mortar or otherwise. Take 4 ounces of logwood and let it be cut or ground into very small pieces; these, mixed with 4 quarts of rain water, must be boiled together until half diminished. Then take 2 ounces of copperas made into a powder, and 3 ounces of gum arabic; let these be also mixed and strained through a linen cloth. After this mixture has stood a few hours it may be written with.

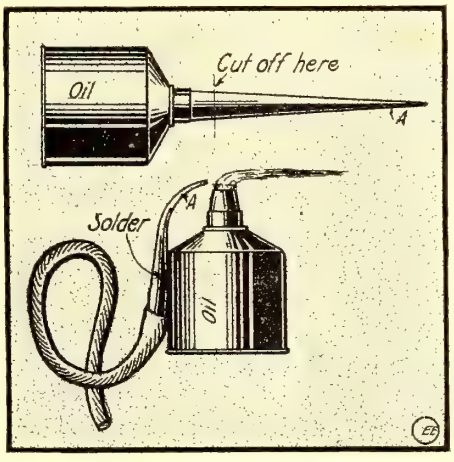
(2) Green Writing Ink.—Dissolve 1 ounce of Hoffman's Permanent Malachite Green in 1 gallon of hot water; add a little gall and alcohol. Reduce with cold water to the required shade.

(3) Sympathetic Ink.—An ordinary solution of gum camphor in whiskey is said to be a permanent and excellent sympathetic ink. The writing must be done quickly, as the first letters of a word have disappeared by the time the last are written. Dipping the paper in water brings it out distinctly, and it becomes invisible again when the paper is dried. It can be brought out repeatedly without affecting its vividness. Contributed by

CHARLES ROSENTHAL.

A HOME-MADE BLOW TORCH.

A good blow torch for the purpose of soldering wire joints and numerous other things may be made as follows: Obtain an oil can similar to the one shown in the



Blow Torch Made from Oil Can.

sketch with a rather long spout. Cut the spout off about half an inch from the top of the can. Next curve it as shown and attach to the larger end a small rubber tubing about 1½ feet long. Solder the spout to the side of the can and pinch the small end of it together a trifle, in order to give a better draft. Place a wick in the can and some alcohol. When using, light the wick and blow in the tube, which will produce a very hot flame.

Contributed by

WENDELL L. CARLSON.

SOME MORE ELECTRICAL DEFINITIONS.

Incandescent bulb: An instrument which burns up your money and makes "light" of it.

Fuse: Something which works steadily most of the time, but which, like other human beings, will have a blow-out once in a while.

Switch: Something which can be put on and off; such as hair, etc.

Magneto: Machine which generates current (except when placed on an automobile).

Buzzer: An electrically operated mosquito.

Electricity: A substance well behaved as a rule, but sometimes quite shocking.

Rotating Field: Seen with varying frequency by some members of the electrical profession and is nearly always produced by a third bottle of "Scotch"; star connected.

Current: The fruit of the dynamo, carried on poles but not used for pies. Contributed by HAMILTON A. HOOPER.

BLUE PRINTS AND BLUE PRINTING.

Since the making of plans is so closely allied with practical work the writer thought that a few words on the manufacture and use of a blue print paper, which can be made and used by the ordinary amateur with excellent results, would not be amiss.

To begin with, procure some tough, well-sized paper, preferably of a good grade, also some citrate of iron and ammonia and red prussiate of potash (recrystallized) and make, separately, two solutions as follows:

Solution 1.—Citrate of iron and ammonia, 1 part by weight; water, 5 parts by weight.

Solution 2.—Red prussiate of potash, 1 part by weight; water, 5 parts by weight.

Mix the two solutions in the dark or subdued light, and apply to the paper with a camel's hair brush or, failing this, a sponge.

The paper is coated by passing the sponge lightly over the surface three or four times, first lengthwise and then crosswise, giving the paper as dry a coating as possible consistent with an even coating. The treated paper is then hung up to dry.

The above paper will require about five minutes to print. For a quick printing paper use a larger proportion of the citrate.

A blue print is made in a printing frame similar to that for printing pictures. The process is, briefly, to expose the tracing, with the blue print paper under it for a proper length of time, and then remove the paper and wash it in water. To print place the tracing with its face against the glass of the frame. Then lay the paper with its sensitized side next the tracing. The back of the frame is then clamped in position and the frame turned over so that the glass is up and the rays of the sun will fall on it at right angles. The above operations should be carried out in the dark or dim light.

When the exposure is finished remove the print, wash it in clear water and hang up to dry in the dark.

Should any lines or dimensions have been left out of the tracing they may be put in the print, using a solution of baking soda in water and an ordinary pen.

Contributed by J. L. GREEN.

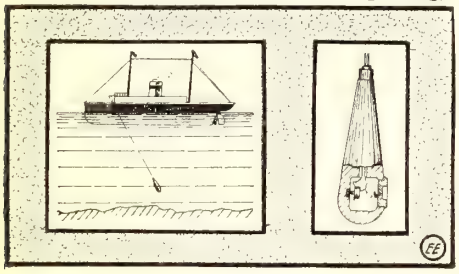
A NOVEL USE FOR HOSE CLAMPS.

Many amateurs connect the ground lead of their wireless to a water or gas pipe. The best method to do this is by using a ground clamp. The author, not having a ground clamp available, used a hose clamp instead. It is used in the same way as a regular type of ground clamp. These hose clamps may be had in sizes from ½ inch to 2¼ inches; the prices range from 2 cents to 9 cents, according to size.—Contributed by FRANK J. ZACHARIA.

If a voice were loud enough to be heard from New York to San Francisco it would take four hours to travel that distance through the air.

ELECTRICAL "SOUNDING" FOR SHIPS.

Believing that depth of water could be measured by mechanical and electrical means from shipboard, a series of experiments were recently conducted from a boat on the Ohio River. The principle adopted and on which the experiments were based was not unlike that of submarine signaling,



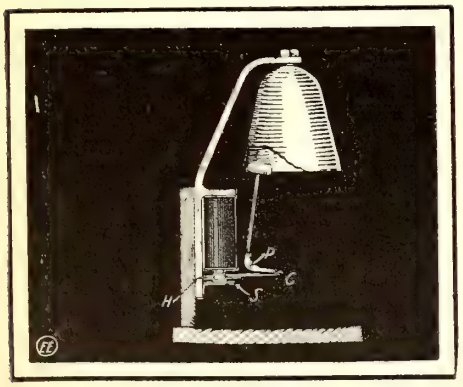
Electrical Device for Finding Depth of Water.

viz., if a sound could be produced on the bottom of the sea such as that caused by dragging a weight across a floor and then transmitted electrically to a telephone receiver at the ear of the pilot on shipboard, a means would be provided which would give warning of the vessel's approach into shallow water. With proper charts, giving speed of boat in knots, length of cable let out and depth of water in feet, it is quite practical to utilize this electrical "sounding" method, which has many advantages over the older method of lowering a weight until it reaches the bottom. A boat can move rapidly and readings taken just the same, says H. R. Gilson in *Electrical Review and Western Electrician.*

AN IMPROVEMENT IN ELECTRIC BELLS.

Considering their importance, electric bells have received singularly little attention, and the design remains substantially as when originally invented. The operation of the ordinary bell leaves much to be desired both from the electrical, mechanical and user's point of view.

A properly designed electric bell should have a hammer arranged to swing through an appreciable arc, while the contact should be made when the hammer is right back and broken only when the armature has come against the pole-pieces. A bell on these lines appears in the illustration. The



New Form of Electric Bell Said to Be Most Efficient.

armature is hinged at H, while the hammer is pivoted at P, the electric contact being at C. The armature rests against the stop S at the beginning of the stroke, while the hammer falls far enough backwards to make the contact C. Current flows through C when the circuit is completed, thereby exciting the magnets which draw up the armature with a jerk, so that the hammer is thrown against the gong and the contact C is also broken. The armature then falls back on to the stop S, and remains there until the hammer falls back and remakes the circuit when the cycle is repeated. The stop S is made springy, which materially increases the force of the blows. Owing to the fact that the contact is made when the armature is right back and not broken until it is against the poles, this form of electric bell is very efficient, while the slow and rhythmic stroke permits the use of musical gongs which ring out with pleasant tones. Laminated magnets give an appreciably sharper hammer blow, and should be used for large bells. The contacts may be made of nickel or similar metal, and are self-cleaning if the metal is thin enough to insure that the pressure is concentrated on a small area where they meet.—*The Electrician,* London.

ANNOUNCEMENT

THE beautiful art supplement with which we present our readers to-day is the little surprise of which we spoke in our June issue.

While we feel proud of our August number, the September issue will eclipse it by far. To begin with, THE MAGAZINE WILL BE ENLARGED AGAIN, the fourth enlargement in five months. Many important new features will be found, all after your own heart. Yes, there will, of course, be another supplement, one over which our "How to make it fiends" will go wild! Then there will be a wonderful illustrated article on Radium, and last, but not least, you will find a rattling good short story in this number, which we know you won't pass up.

If you are not a subscriber, order the September issue without fail to-day, so your dealer won't tell you, "sold out." Also before we close, remember:

EXPECT MUCH

VOLTS FOR WOMEN.

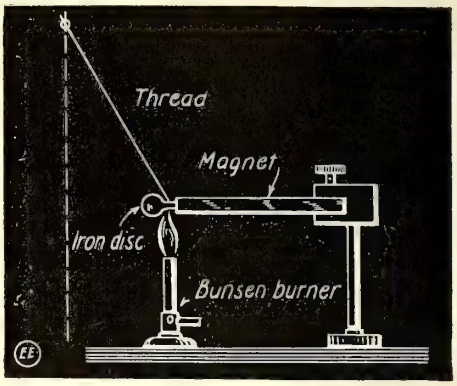
There may be some among our readers to whom the newspaper item about Policeman Ohm being put in a cell means very little. As for ourselves we merly inquire, "Watt for?" and whether he made much resistance. If so, he probably got hot about it. His attorney wanted him discharged, so he could light out. He lost his star connection. Somebody blew on him. Poor man.

EFFECT OF HEAT ON MAGNETISM.

An interesting experiment, depending for its action on the fact that iron when heated ceases to be magnetic, is here described.

A pointed disc of sheet iron is suspended by a thread and is placed with the point against the magnet, which holds it there by attraction. A flame is allowed to burn under the point, which when heated strongly is no longer attracted by the magnet, and therefore swings away. By the time that it has completed its swing it has cooled sufficiently to be attracted again by the magnet.

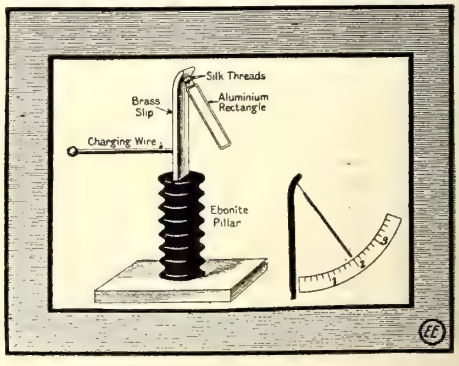
The iron, becoming reheated, swings away again and the cycle of events is repeated. The iron disc should be large enough to cool by radiation sufficiently (during the swing) to become magnetic again, says a writer in *Model Engineer.*



Demonstrating the Effect of Heat on Magnetized Iron Disc.

ELECTROSCOPE FOR LECTURE TABLE USE.

In his recent lectures at the Royal Institution on photo-electric phenomena, Dr. J. A. Fleming made use of an ingenious form of electroscope which he has devised for lecture purposes. In Dr. Fleming's electroscope a slip of brass about 0.25 inch wide and 2 inches long is fixed vertically on the top of a corrugated ebonite or sulphur pillar. The top of this metal slip is slightly bent over. A rectangle made of fine aluminum wire of nearly the same width and length as the slip of metal is attached by two very short cocoon silk fibers to the top of the rectangle, and these fibers are wetted with a solution of chloride of calcium to make them conduct. When the system is not charged the rectangle hangs vertically in contact with the metal slip. If a charge is given to it the rectangle stands out at an angle as seen. It is essential that all edges of the metal shall be carefully rounded so as to leave no sharp points. To the back of the metal slip may be attached a thin wire ending in a small ball, which is convenient for making contact with electrified objects. For lecture purposes the image of the electroscope can be projected on the screen by placing it in



Large Lecture Table Electroscope.

a parallel beam of light and employing a projecting lens and correcting prism. Dr. Fleming employs as a screen a large sheet of paper, on which a curved arc divided into degrees is drawn, as depicted at right of sketch. The radius of this arc is adjusted to be the same as the length of the image of the aluminum rectangle, so that the end of that image moves over the arc, as apparent.—*The Electrician,* London.

LATEST PATENTS

Telephonic Relay or Amplifier.

(No. 1,140,366; issued to Henry C. Egerton.)

A rather novel form of telephonic relay or amplifier arrangement, comprising, as shown, a soundproof case, 5, containing in

Fig. 1.

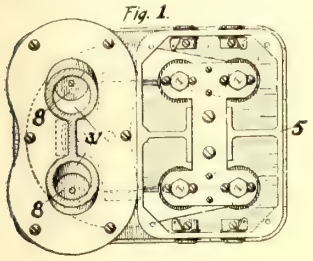
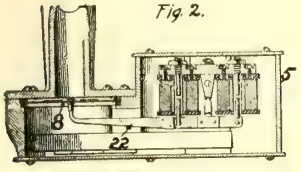


Fig. 2.

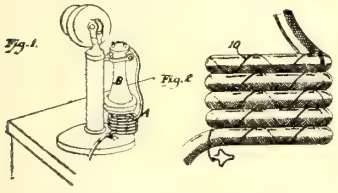


two divided compartments of same two distinct sets of polarized electro-magnetic mechanisms with pivoted armatures 22, as observed. One side of a telephone line is connected with one set of electro-magnets and the vibrations of their armatures vibrate in turn a diaphragm 8. This sets up (acoustically) air vibrations in the return air chamber 31, causing the second diaphragm 8, on the other side of the case, to begin vibrating synchronously. When this second diaphragm starts vibrating it also moves its attached pivoted armature, and this sets up periodical changing electric currents in the second set of electro-magnetic windings, which connect with the second part of the circuit, etc.

Telephone Cord Coiling Device.

(No. 1,140,980; issued to Lorenzo E. Haynes.)

We are all more or less familiar



with the troublesome telephone receiver cord, which is forever getting tangled up with something or other. This inventor causes the cord to automatically resume a spiral coil form, very compact and neat, as the illustration shows. A steel wire 10, specially coiled, for instance, is suggested to be secured on the telephone cord "A," causing the action just explained to take place automatically when the receiver "B" is hung up.

Improved Dry Battery.

(No. 1,140,826; issued to William Hoppie.)

Concerns improvement in the manufacture of electric dry cells with the object in view of providing a battery device having improved means, whereby the life of same may be materially lengthened. Further the invention relates to the

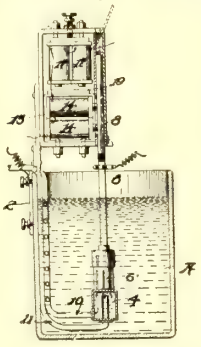


use therein of mercury and aluminum, which are decomposed by chemical affinity and the metallic atoms electrolytically deposited on the zinc, protecting thereby and prolonging the life of the zinc, making it a more active element and generating a higher electro-motive force. Several other improvements are covered in the patent, such as improved container, insulation and non-buckling features for same.

A Magnetic Oscillation Generator.

(No. 1,142,496; issued to Alfred H. Cohen.)

A magnetically operated oscillation generator, intended to be used in a wireless transmitting circuit for producing radio-frequency oscillations directly. The main circuit current is broken in an insulating bath "A" in a container 2. The lower electrode 4 is water-cooled, as also the bath, by suitable tubes 10 and 11. The upper electrode 6 is raised by a peculiar magnetic system 14 and 17. The upper electrode 6 is joined to an iron lifting rod 8. The electro-magnets 14 first act on this rod and an instant afterward the upper set of electro-magnets 17, 17 attract an iron armature 19 on the movable magnet frame 13. By this compound magnetic action the patentee claims to be able to synchronize and properly tune up a set of these interrupters operating in series, etc., so that they will work to a maximum efficiency in a perfect manner. They are intended to be hooked up directly across the dynamo circuit and to have a capacity and induct-

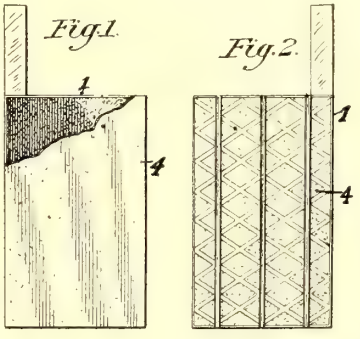


ance shunted across the gaps here described.

Storage Battery Plate.

(No. 1,141,251; issued to Joseph O. Luthy.)

A novel method of improving storage battery plates and to prevent the active element of same from disintegrating or peeling off. This patent covers a process for coating the outside of the battery plate 1 with a porous, enamel-like



coating 4 which, it is claimed, does not lower the efficiency of the battery in any way or introduce any undue resistance, as proved by actual tests. A method is also mentioned for improving this process by having the enamel coating supported on a fine mesh screen. It is claimed that this patent absolutely prevents the active element of the plate from falling out or becoming damaged otherwise, electrolytically (? *Editor.*)

A Magnetic Brad-Set.

(No. 1,141,073; issued to Charles H. Parks.)

Fig. 2.

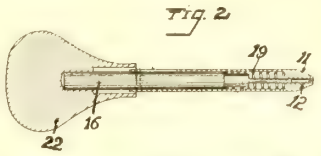
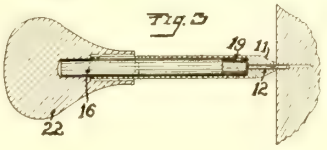


Fig. 3.

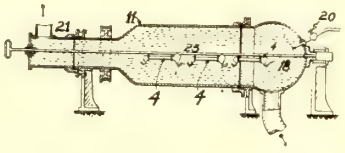


Another practical application of magnetism. In this particular invention there is provided a magnetized steel bar 16, which is repelled out of the hollow barrel 11 by a spiral spring 19 within the barrel. Small iron brads, etc., are held within the opening of the barrel 12 by the magnetized stem of the steel rod. By exerting a sharp, quick pressure on the ram head 22 the brad is driven home.

Ultra-Violet Ray Water Purifier.

(No. 1,140,819; issued to Victor Henri, André Helbronner and Max von Recklinghausen.)

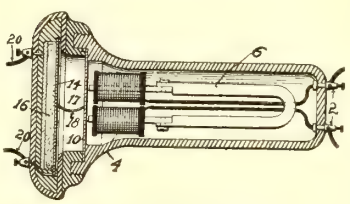
A new form of ultra-violet ray device for water purification purposes. Ultra-violet ray tubes 4, such as quartz mercury vapor lamps, are mounted on a suitable support 8 within a rotatable water chamber 11. In operation this chamber is filled with water from the inlet 21 and when full the chamber 11 is rapidly rotated. This causes the water at the center, by centrifugal force, to leave a vacuous space at the center, as indicated by the dotted line space 23. Thus the water does not come in contact with the tubes, yet the rapidly swirling mass of liquid is thoroughly permeated by the ultra-violet ray and thus sterilized. The air space 23 may be varied as to size by admitting more or less compressed air through pipe 20.



Simple Telephone Repeater.

(No. 1,143,173; issued to Gustavus A. Janicke.)

A very simple form of telephone repeater or amplifier whereby the telephonic currents enter terminals 2, joined to the usual electro-magnetic coils 4, mounted on permanent magnet 6. In front of their pole pieces is a diaphragm 10, connected by a metallic wire 18 with a second diaphragm 14, behind which are carbon granules forming a microphone 16. The space 17 between the two diaphragms 10 and 14 is air-tight, so that each diaphragm can vibrate independently of the other, as the wire 18 is flexibly



joined to the diaphragms. The secondary circuit of this repeater or amplifier is joined to the wires 20, connecting with the microphone.

Electric Soldering Iron.

(No. 1,142,306; issued to John G. Clemens.)

A distinctly novel form of electric soldering iron, quite different from the usual form we are familiar with. This device is arranged to pass electric current through one of its electrodes 11, through the wire joint to be soldered and thence back to the second electrode 12. The patentee mentions that it is best to make these electrodes 11 and 12 of some high resistance material, such as German silver, etc., so as to cause as much heat as possible to be generated by the passage of the current through these parts. Also, no solder is used on the "iron"

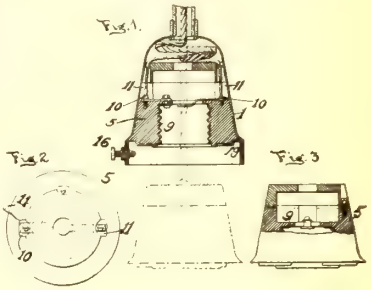


proper, as is the case with ordinary soldering coppers.

Improved Lamp Socket.

(No. 1,140,498; issued to Charles L. Cassidy.)

The inventor of this electric lamp socket has endeavored to make it

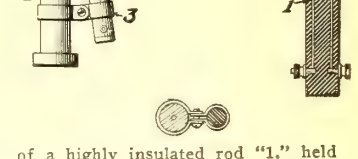


as simple as possible from the manufacturing point of view. The shell "1" is made from one piece of stamped metal and, as the dotted lines show, the interior insulation plug "5" carrying the lamp base contacts "9, 10, 11" slides forward when the three retaining screws "16" are removed. The plug "5" is held in place by a flanged ring "19." The screws "16" hold this ring in place and also secure lamp shades or reflectors. A promising patent.

Electrical Head-Lamp Igniter.

(No. 1,139,759; issued to Francis N. Fox.)

This patent covers construction



of a highly insulated rod "1," held in a suitable clamp "3" and which rod carries two distinct electrodes "9," which have between their upper free ends, a spark gap of short length. A regular high tension ignition coil can thus be connected to these two insulated sparking wires "9" and it is thus possible for the owner of gas head-lamps to light them from the seat of his automobile.

(Copies of any patent above mentioned supplied at 10 cents each.)

AMONG THE AMATEURS

AMATEUR RADIO STATION CONTEST.

Monthly Prize, $3.00.

This month's prize winner.

JOHN J. GROSSMAN'S WIRELESS STATION.

Herewith is photo of my wireless station, which I should like to appear in your valuable magazine.



Views of Mr. Grossman's Wireless Station and One of the 70 Foot Aerial Masts. Also a Likeness of the Owner of This Very Efficient Plant Appears Below.

This station made some records in the past winter, having worked with the University of North Dakota, 920 miles; with Northampton, Mass., and 8 O. Z., Kane, Pa., several times. We are a *sure link* in the American Radio Relay League and the Central Radio Association, as we have two operators and are "in" right along. An Audion set is used for reception.

Tiffin, O. JOHN J. GROSSMAN.

E. C. WAIDLER'S LABORATORY.

Herewith is photo of my wireless outfit. It consists of a ½-K.W. transformer with meters, regulators and an air-cooled gap. The receiving set is composed of a Ferron



E. C. Waidler Busy in His Wireless Laboratory.

and Perikon detector, two fixed condensers and a Blitzen variable condenser, a loading inductance of 3,000 meters' capacity and a receiving transformer of my own make.

My aerial is composed of six copper-clad wires on 12-foot spreaders, and is 75 feet long by 80 feet high. I get Arlington every night and sometimes I hear Key West and Colon. I also use a Geissler tube for a radiation tester and it works very satisfactorily. I think your magazine is excellent.

E. C. WAIDLER.

East Toledo, O.

Beech's Wireless Installation.

Herewith is presented the radio station of Guy Beech, of Clarinda, Iowa. The sending set comprises the following instruments: One-quarter-inch Bulldog spark coil, key, home-made condenser, helix and spark gap. The receiving outfit is com-



Guy Beech and His Radio Outfit.

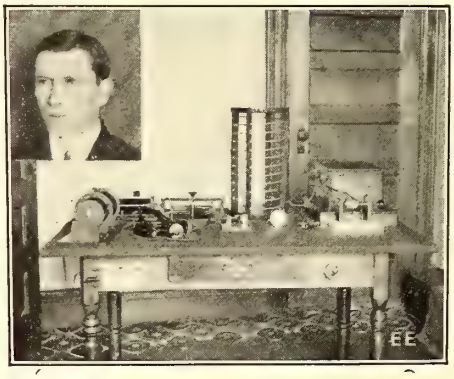
posed of a 75-ohm receiver galena detector, "junior" fixed condenser and tuner.

Good results are obtained with this set and Arlington and (I. W. Co.) Illinois Watch Co. can be easily heard.

Clarinda, Iowa. GUY BEECH.

HOOVER WIRELESS PLANT.

The receiving set of my wireless outfit consists of a loose coupler made from a design given in Modern Electrics. A variable condenser, Brandes' navy 'phones loading coil and perikon detector, from crystals furnished by Electro Importing Co. The sending set is a ¼ K. W. closed core transformer, with glass plate condenser, helix, key and spark gap. I use a sending wave of 190 meters. I notice only about two out of ten amateurs seem to



Raymond Hoover and His Neatly Arranged Wireless Set.

have a Government license; I would like to see all the amateurs get a license, it is so easy to procure. They only try you in one wireless code, and very slow. Also the questions asked most any amateur knows. My call is "2 L. Y."

RAYMOND HOOVER.

Newark, N. J.

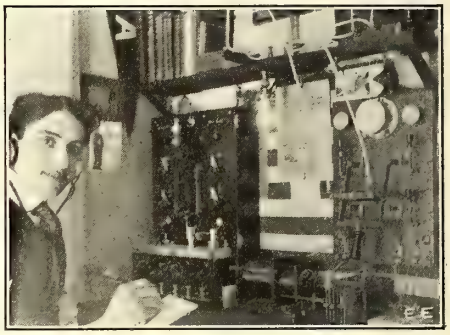
To find the approximate wave length of radio aerials multiply the total length of aerial in meters by 4.5.

ANTONE SYLVIA'S STATION.

I give you herewith a photograph of my wireless station for publication in your magazine. The station comprises the following:

Two loading coils, a loose coupler, one sliding plate variable and a Clapp Eastham rotary variable, two fixed condensers, one silicon detector and one Perikon, one pair of Brandes' 'phones, transatlantic type, and also one pair of Brandes' navy type. The cabinet set was designed and built by myself. I use an inside antenna and get good results.

Sending outfit includes Mesco 1-inch spark coil, spark gap, a Clapp Eastham ¼-K.W. helix, one section of Murdock condenser and Mesco key mounted on a



Mr. Antone Sylvia's Excellent Radio Station.

marble base. The station also has a switchboard, seen at the right, which contains all the necessary switches to operate the station.

The microphone seen in the picture is used for wireless telephone experiments and, using the inductive system. I have talked about four blocks away, or 518 feet, to be more exact.

I have read your magazine and find it valuable for radio experimenters.

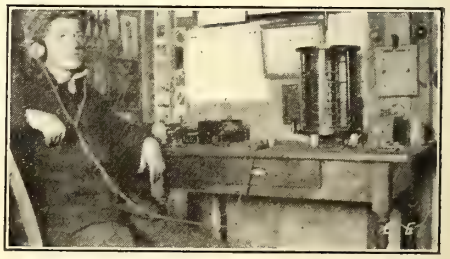
ANTONE SYLVIA.

New Bedford, Mass.

RADIO SET OF F. F. DENNIS.

Below is photo of myself and my radio receiving and sending apparatus. My aerial is 135 feet long and 60 feet high, and consists of five wires 2 feet apart. My receiving apparatus consists of one double-slide tuning coil, one E. I. Co. single-slide tuning coil, one fixed condenser, a galena detector and one pair of Brandes' 2,000-ohm superior 'phones.

My sending apparatus is composed of a 1-inch spark coil, one home-made condenser, Mesco key, large home-made helix,



Wireless Signals Coming in at Station of Fred Dennis.

zinc spark gap, 10 dry cells and a three-pole double-throw switch. The receiving range is about 600 miles at night.

I would be pleased to talk to any amateur within by range, or will be glad to hear from anyone. My call is 2 J. T.

Fair Haven, N. J.. FRED F. DENNIS

Phoney Patents

Under this heading we will publish hereafter electrical or mechanical ideas which our clever inventors, for reasons best known to themselves, have as yet not patented. We furthermore announce the grand opening of the

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PHONEY PATENT OFFIZZ

A. WALL-EYED PIKE, OF MOMBASHIA, N. Y.

No. 41144¼ (For Luck) **FISHERMAN'S DELIGHT** **Patent not Applied for June the foist, 1915**

Specification of Phoney Patent
Application junked December the onc't, 1890½

To Those Whom It May Not Concern:

I, Wall-eyed Pike (note the hyphen), of the Principality of Mombashia, N. Y., have invented means whereby the *sadly neglected fisherman* has come into a heaven of his own, by virtue of my marvelous invention, which shall be known hereinafter, henceforth and ever after, as the "Fisherman's Delight."

Just why the fisherman, on whom we all depend at times for food, has been so sadly neglected by the numerous inventors of our marvelous age is hard to reason out, and therefore I have devoted my best energies in perfecting an invention, so devised that when the tired fisherman is at home he can have all the peaceful slumber he cares to indulge in, without having to arise early in the morning, or in fact any time in the morning, to catch a mess of fish for dinner.

In further description of this infamous scheme, the reader is referred to the hieroglyphical sketch, and the various parts are numbered to correspond with inscription given below: To begin with, the basic part of this wonderful invention, albeit, centers on the rain-catching tripper 1. On a fine rainy morning, the "Tomato can" fastened to switch lever 2 soon becomes filled with water, opening the lever switch contacts 3. Thus the electrical circuit 4 is prevented from operating when the alarm clock 5 operates in the early hours of the morning. If it is a bright, fair morning the lever switch 2 remains closed, and when the clock 5 goes off it closes the electrical circuit 4, by means of battery 6 and wires 7, to start operating an electrically driven rising and falling baited net mechanism 8. The net is depicted at 9.

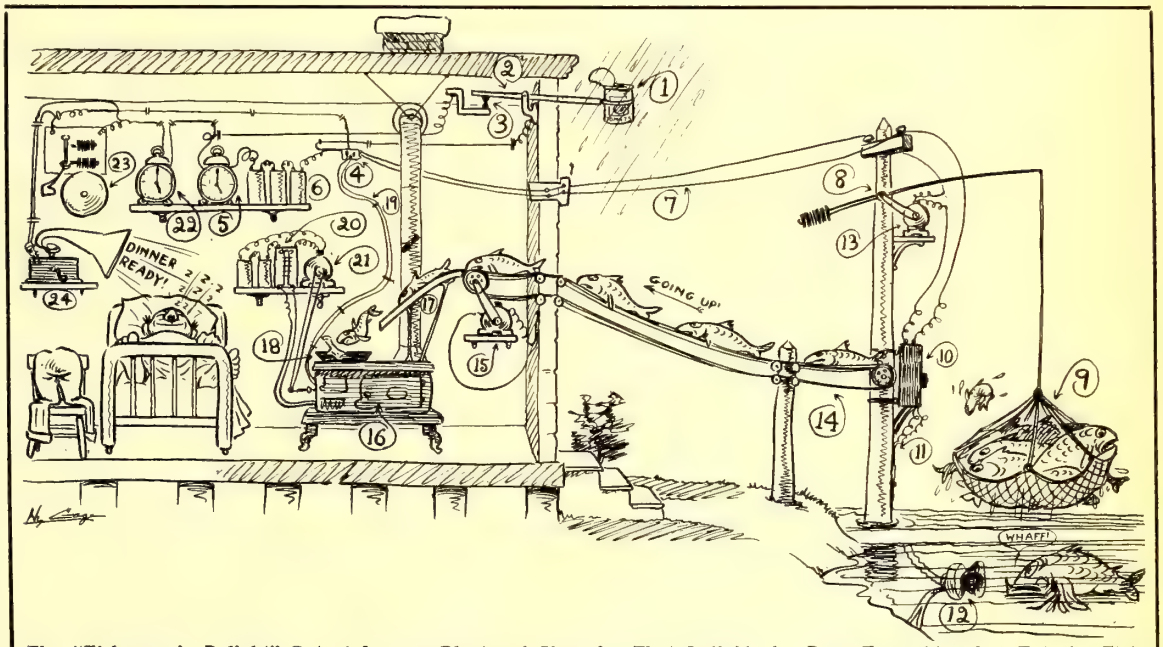
This part of the apparatus may seem somewhat hazy to the uninitiated, and so we hasten to explain. At 10, on one of the wooden piles supporting the fish-catching parts of the perfected "Fisherman's Delight" machinery, is mounted an automatic electrical relay device, which is hooked up with a couple of heavy insulated wires 11 to a very sensitive microphone 12. Now this device is so arranged that when the clock 5 closes the circuit 7 in the morning, the electric motor 13 moves the lever 8, to lower the net 9 into the water. As this net should not be raised until filled full of fish, of course, some arrangement must be provided that will close the circuit of the motor 13 again to raise the net only when the fish have entered same.

I duly provide for this function by means of a sensitive microphone 12 (which has been used by fishermen for some years to "hear" fish approaching). When the school of fish approach the baited net their swishing about in the water sets up sounds, and these strike the microphone 12, which communicates them electrically to the relay 10, and so the net is raised into such a position that it ejects the fish on to the moving belt conveyor 14, which is driven in the house by an electric motor 15, whose circuit was closed by the clock 5 when it first went off in the morning. This belt conveyor is always moving and carries the fish into the house, and when they near the stove 16 they are precipitated through an inclined shute 17 into the frying pan 18.

The fire in the stove 16, which may use wood, coal or oil, etc., is to be started by electric current through the wires 19, joined on to the circuit 7 from the clock 5. When the fish have been fried sufficiently and, conjointly, when the fire has burned to a sufficient degree of heat, it will cause a thermostat 20 to operate an electric motor 21, which will close the damper or regulator of the stove.

This whole arrangement is, of course, to be so proportioned and designed when practically installed, that all of the foregoing operations will take place in the forenoon and at dinner time the alarm clock 22 will then operate, and should the fisherman not hear the ordinary bell, it is arranged to close a circuit through a **12-inch** fire alarm gong 23.

A somewhat more gentle awakening device may be provided, if preferred, by utilizing a talking machine 24, electrically actuated or started from a circuit such as that connected to the gong 23. Some folks prefer to be awakened according to the latest scientific theories, or by music; and so a musical record may be placed on the machine, or if the announcement, "Dinner Ready!" is preferred, then a specially prepared record may be made with a continuous rapid-fire string of such words on it.



The "Fisherman's Delight" Patent Insures Plenty of Sleep for That Individual. Does Everything but Eat the Fish.

In testimony whereof I have hereunto scrawled my name this foist day of December, 1890½.

A. WALL-EYED PIKE.

By his attorney:

S. W. Healy, Troy, N. Y.

Witnesses:

A. DILL PICKLEFRESSER,
I. M. A. HELGAMITE,
A. BLACK BASS.

Chappie—"Electricity is wonderful. I tell you it weally makes one think."

Miss Cutting—"Yes; why don't you get a battery?"

QUESTION BOX

This department is for the sole benefit of the electrical experimenter. Questions will be answered here for the benefit of all, but only matter of sufficient interest will be published. Rules under which questions will be answered:

1. Only three questions can be submitted to be answered.
2. Only one side of sheet to be written on; matter must be typewritten or else written in ink, no penciled matter considered.
3. Sketches, diagrams, etc., must be on separate sheets. Questions addressed to this department cannot be answered by mail.

RADIO LAW AND WAVE LENGTH.

(294) C. Howard E——, Sandwich, Mass., asks several questions relative to the wireless law, etc.

A. 1. We are pleased to advise you as follows regarding your radio queries:

The matter of a wireless license, as required by the radio law now in effect, is explained in detail in papers procurable from your local radio inspector; address care of Custom House, Boston, Mass.

This law requires that where an amateur is to transmit wireless messages his radiated wave length shall not exceed 200 meters in value.

Also with regard to the latest rulings with respect to the U. S. radio law and experimental radio-transmitting stations, would say that where the amateur radio-transmitting station is located so far inside the State border line that it cannot transmit over the border line no Government license is required, ordinarily. However, if this station can interfere with the transmission and reception of commercial or Government radio messages over that State border line, then the amateur transmitting plant must have a license, and this decision has been handed down recently in several court cases.

STORAGE BATTERIES.

(295) William A. Collins, Philadelphia, Pa., writes us regarding storage battery capacity, lamps to be used, etc.

A. 1. The usual discharge rate for 6-volt 60-ampere-hour storage battery is about eight hours, or in other words, about seven to eight amperes for that period.

As the volts times the amperes give the watts used in the circuit, you can readily, of course, figure out how many lamps you can operate of any type you are interested in, figuring 1 watt per candlepower for the battery-type tungsten lamps.

LIGHTNING RODS vs. WIRELESS.

(296) Clifford Pinkerton, Spencer, S. D., wishes to know whether lightning rods on a building will affect a radio antenna on the same building.

A. 1. Lightning rods, of course, will have some effect on wireless aerials, as they tend to dissipate some energy in the earth.

However, they are generally of relatively small area as compared to the large metallic spread of the antenna, so that they do not have such a great effect as might be imagined. This refers to either indoor or outdoor aerials. Also the aerial proper should be placed as far as possible from such conductors.

SPARK GAP QUERIES.

(297) C. D. Blair, Richmond, Va., wants data on best form of spark gap to be used on radio transmitter, employing electrolytic interrupter, so as to give the highest pitch possible.

A. 1. You can improve the tone or pitch of your spark by using a quenched gap. It is not usually beneficial to use a rotary-type gap with electrolytic interrupter, as the interruption frequency is not regular enough.

Hence to realize the best results with a variable frequency in the primary you should use a quenched gap, as this form of gap will operate on any frequency very nicely, and it makes practically no difference in the design of the gap whether 60 or 500 cycles are used in the transformer primary circuit.

We believe this to be the best solution of your problem, and of course you can raise the spark tone some by careful adjustment of the electrolytic interrupter anode.

RECEIVER GIVES SOUND WITHOUT DIAPHRAGM.

(298) A. B——, Amboy, Ind., inquires for construction data of 3,000 meter loose coupler.

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A. 1. You will find this data, with complete working drawings, given in the March, 1914, issue of this journal.

A. 2. As far as we know, a person holding a commercial radio license can obtain a position in a land radio station without first serving at sea.

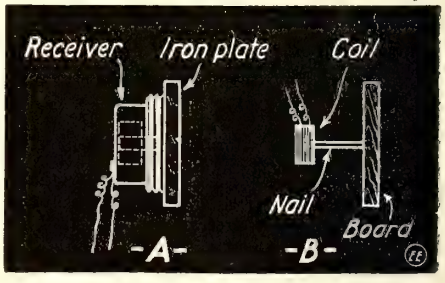
A. 3. We are very much interested in your experiment whereby you cause a telephone-receiver shell and magnet only, without any diaphragm and cap on same, to give forth a sound as usual.

This matter has been explained in several ways from time to time, and as near as can be judged from the various theories and explanations regarding it, it is based on the change of the molecules making up the iron core in the receiver. We should imagine that with a receiver connected across the vibrator of a buzzer, as in your case, the sound heard in the receiver would be naturally more pronounced than if speech were being reproduced, owing to the fact that the buzzer *make and break impulses* are very strong.

We give herewith sketch showing how a very interesting experiment can be made by means of a telephone receiver without the usual diaphragm. We may say, before going further, that in all these experiments it has been found best that the coils shall be wound rather loosely, but not necessarily so loose that the turns can jump about or vibrate.

In the sketch a peculiar experiment is shown at "A," where a thick iron plate, which may be as thick as 1 inch, is placed in front of the receiver and the magnet coil and the pole piece of same acts on this plate. Speech has been reproduced in this way, and of course, as it is impossible for the small receiver to vibrate the whole plate by bending it in the way the diaphragm of 1/64-inch iron does, the iron must vibrate in unison with the speech waves, etc., by molecular vibration.

Regarding the exact theory of how these molecules become magnetized and demagnetized so as to manifest this change in their condition physically, this is not very



Telephone Receiver with Thick Iron Diaphragm at A; Board Reproduces Speech When Arranged as at B.

well defined. It has been pointed out by several authorities such as Silvanus P. Thompson, of England, that a *magnetized* steel bar is longer than when it is *not magnetized.* He has also stated that a definite click can be heard when the bar is magnetized and demagnetized, and he says theoretically that this is undoubtedly due to the fact that the molecules when magnetized tend to set themselves, end to end, and thus the steel bar is lengthened.

It may be said that in such experiments with solid iron plates or bars having coils mounted on them to create speech without the usual diaphragm, the iron used is always best of very soft or cast stock, and steel works very poorly, if at all.

At "B" in the sketch is shown another experiment of interest where the receiver magnet coil has inside it an iron nail with, preferably, a good, large head on same. The nail is driven into a piece of board as shown. If this board is held against the ear, it will be found that the speech can be heard all right, as well as if a regular receiver were used, but of course not quite as loud. The board acts probably as a sound-resonator.

FATAL SHOCK FROM TELEPHONE WIRES.

(299) William F. M., Jr., Cleveland, O., says he has read of people having been electrocuted by coming in contact with telephone circuits, and wishes to know how this is possible.

A. 1. It has happened a number of times that people have been electrocuted by coming in contact with telephone wires where there seemed no possibility of such a thing happening.

It has usually been found the case, however, when such fatal results have occurred, that the telephone circuit with which the person came in contact was crossed, perhaps temporarily, due to a broken wire, etc., by a high-voltage lighting or power wire carrying several thousand volts.

It is readily seen, then, that a person coming in contact with the telephone wire so charged would, in many cases, complete a circuit to earth through his body, and undoubtedly fatal results would obtain.

The fuses you speak of in the telephone circuit would not be of any benefit in such a case, for the reason that the current of dangerous potential would be several thousand volts and the current in amperes would only have to be a fraction of an ampere to prove fatal. Then again, it is quite possible that the circuit through the body would be made over a full metallic circuit in which no fuses were inserted.

1,000 AND 75 OHM TELEPHONE RECEIVERS ON ONE CIRCUIT.

(300) A. E. Eichner, Trenton, N. J., is using a 75 and a 1,000-ohm telephone receiver on a common circuit, and wants to know why they don't talk good, telephonically.

A. 1. The reason why you cannot get good results using the 1,000-ohm receiver is due to the fact that the voltage generated by the movement of the diaphragm in either case is not correctly proportioned to operate the opposite receiver, owing to the different number of turns on each coil, etc.

In other words, you will appreciate that if, for instance, the voice waves operate or move the diaphragm of the 75-ohm receiver, currents will be generated in the magnet coil of same which will have only a few volts potential, with a comparatively large current value.

These currents, of course, when they reach the high-resistance receiver with many thousands of turns of wire on it at the other end of the circuit, cannot operate same efficiently, as such a high-resistance receiver is suited to, relatively speaking, high voltages with small current values, and vice versa.

You will readily understand how the 1,000-ohm receiver would have generated in it currents of much higher voltage, of course, than a 75-ohm receiver with a consequent very small current value, and as the 75-ohm receiver, as we know, requires a relatively low voltage with a strong current value, the current passing over the circuit from the 1,000-ohm receiver will not operate efficiently the 75-ohm instrument at the opposite end of the line.

You will always find in this sort of work, as well as in most telegraphic circuits, etc., that the instruments should approximately be balanced to each other as regards current, voltage and resistance ratings.

BUZZER INDUCTION CURRENTS.

(301) Wynn Boyden, Medina, O., states that he has been able to transmit radio signals by a buzzer, and asks why it is


"Friar's Lantern"

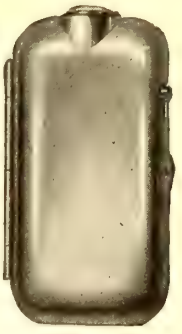

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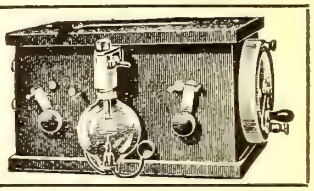
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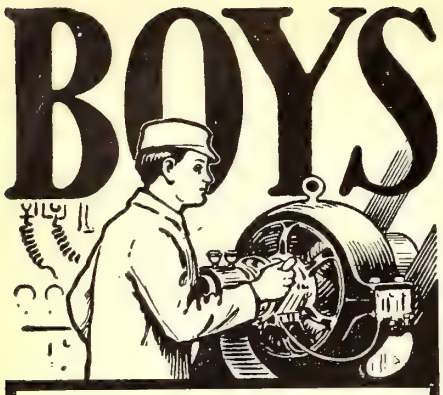
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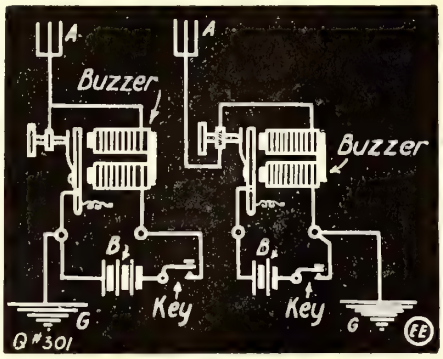
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that the same results are obtained whether the aerial and ground are connected across the vibrator or across the whole buzzer circuit.

A. 1. In regard to your wireless transmission by buzzer, would say that it is generally found that practically the same results are obtained whether the ground and aerial wires are joined directly across



Showing Buzzer Connected in Two Ways to Aerial and Ground.

the buzzer vibrator, as diagram A shows, or across the whole buzzer-induction circuit, as indicated at B.

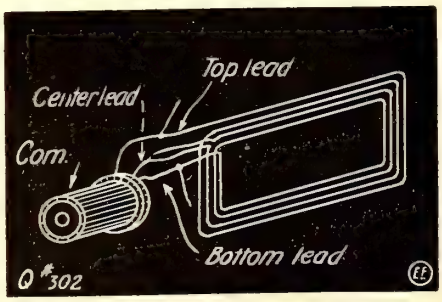
In any case, the increase of voltage in the circuit by self-induction whenever the vibrator breaks the circuit will be evidenced throughout the circuit, and is bound to charge the aerial and ground conductors whether one of these wires is joined ahead of the magnet coils in the circuit or behind them, due to the reason that the self-induction surge in the circuit passes throughout the whole circuit, roughly speaking.

ARMATURE WINDING.

(302) Gilbert M. M———, Savannah, Ga., asks us about hooking up leads from a motor armature which has one-half as many slots as commutator bars.

A. 1. Regarding the winding of small D. C. motor armature containing twice as many commutator bars as slots for winding, the diagram will help to show how this is usually done, especially on small armatures such as those used in fractional horsepower motors of the fan type.

As you will see from the diagram, there is a loop or lead left out in the middle of each coil as it is wound, lap-fashion, and thus each coil will have three leads projecting from same, and for small armatures it is common practice to place the central lead half way through the coil as regards the number of turns in the coil. For instance, if the coil had two hundred turns of wire in it, at the 100th turn the center or looped lead should be left out. In other words, this lead would be left



How Armature Coils Are Tapped by a Middle Lead When Twice as Many Commutator Segments Are Used as Slots in Armature.

extending several inches. With such complicated windings it is always invariably the best policy to mark these center leads in some way with a piece of string, etc., so that when joining the leads to the commutator the proper sequence will be followed without any trouble. Otherwise the coil is liable to be connected to the commutator backward.

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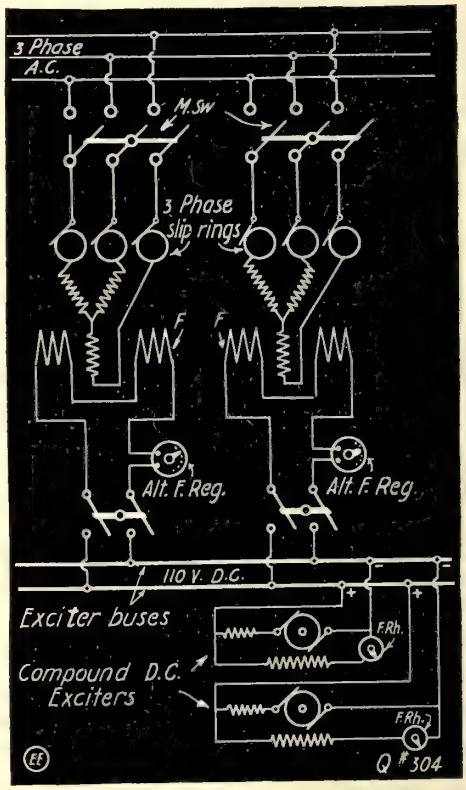
(303) Alan E. Simmons, Palmetto, Fla. We do not know just what arrangement you intend to use, but from what we know of the matter of electrical plant culture it may be said that a regular spark coil and high-frequency set is generally utilized for the purpose.

Also it would be possible to utilize a closed-core wireless-type transformer giving a high voltage at the secondary, such as a ¼-K.W. unit, developing 10,000 to 12,000 volts.

High-frequency current could then be produced by means of this transformer and a suitable helix and condenser in the regular way.

PARALLEL OPERATION OF TWO A. C. GENERATORS.

(304.) Mr. C. O. W———m. White Plains, Ky., asks us about a problem he has relative to parallel operation of two A. C. generators, also several other queries.



Suggested Hook-Up of Two Exciters and Two 3-Phase A. C. Alternators to Give Steadiest Operation.

A. 1. With reference to the parallel operation of two 75 kilowatt, 60-cycle, 220-volt, 3-phase A. C. generators would say that the special diagram you show where exciter No. 1 is hooked up with the rotating field winding of alternator No. 2 and exciter No. 2 with alternator field No. 1 is quite practical and has been used considerably in practice so as to help keep the two machines driven from separate engines in as nearly as possible strictly synchronous relation.

This arrangement, however, has a bad disadvantage in that if one of the alternators should for some reason be shut down quickly it would affect the *exciter* of the *second alternator;* and thus the whole plant will be shut down. This naturally would be a bad state of affairs.

(*Continued on page* 170.)

PATENT ADVICE

Edited by H. GERNSBACK

In this Department we will publish such matter as is of interest to inventors and particularly to those who are in doubt as to certain Patent Phases. Questions addressed to "Patent Advice" cannot be answered by mail. Sketches and descriptions must be clear and explicit. Only one side of sheet should be written on.

Applying for His Own Patent.

(6) Benjamin Hurst, Los Angeles, Cal., would like to know if it is feasible for him to make his own patent application at the Patent Office instead of engaging a patent attorney to do the work.

(A.) While quite a few people prosecute their own patent business and apply for patents themselves instead of through a patent attorney, we would advise that unless the would-be applicant is an attorney himself or knows legal phraseology, not to attempt it, for he will be sure to overlook the most vital points. It is not enough to just describe your invention and send in a drawing showing what the idea consists of, but the most important part in a patent is the "claim." These claims, which make a patent valuable, are quite technical and the average layman does not as a rule understand the language used in them. Where the layman could usually not find more than two or three claims to a given patent, an experienced patent attorney will easily find from ten to twelve, and while the Patent Office may not allow all the claims, they certainly, as a rule, will allow more than the layman could make up.

In our opinion it is always best to engage a reputable attorney to obtain a patent and while the cost may be greater, on the other hand, the protection is vastly greater also. It has, as a rule, a certain value which the same patent obtained by the untrained layman would not have.

Cost of Patent.

(7) Edwin P. Powell, Red Bank, N. J., desires to know how much it would cost him to patent an invention.

(A.) A patent can be obtained for as low a price as $50 from reputable patent attorneys if the invention is a simple one and does not require more than one sheet of drawings and if it is not too complicated.

If a long search in the Patent Office is necessary in order to convince the attorney that it is safe to go ahead with the application it must be, of course, understood that such extra work must be paid for. As a rule it would be safe to say that simple patents with one sheet of drawings would not come higher than $75 with most reputable attorneys. If the patent is extremely complicated and has many sheets of drawings the cost will, of course, be much higher.

We would advise correspondents to send for all literature of patent attorneys and ask for their fees. Most of the attornevs get out attractive booklets that very often contain valuable information which the inventor who is interested in patents should possess by all means.

Can He Trust Attorney?

(8) A. B. Wilson, Pittsburgh, Pa., writes as follows:

"I have invented a new loud talking telephone receiver which I am sure will revolutionize the present telephone receiver. My telephone receiver has several new points not found in any other receiver and, being cheaper to manufacture and talking very much louder than the ordinary one, I think that my invention is quite important and this is what I would like to know:

"I have heard that some patent attorneys have appropriated inventions themselves or otherwise have given out information obtained from their clients to the detriment of the original inventor. Therefore I do not feel like trusting an unknown patent attorney and would like to have your advice just what to do."

(A.) This is one of the fears uppermost in the minds of most inexperienced inventors and we might say that it is a very groundless fear. It should be understood that patent attorneys are professional men, the same as your doctor, and while there are cases on record where patent attorneys have appropriated ideas, the total of such cases, as to the number of inventions which actually have been patented, is less than twenty in a million.

From this you can understand that an inventor does not take a great chance bv trusting a patent attorney with his invention. As a rule the latter considers one patent much the same as another, and very few if any bother to think about the commercial possibilities of inventions as a whole. We have not heard of a single case during the last ten years of a patent attorney appropriating any ideas of his client and for this reason we think that you may trust yourself safely to most any reputable attorney.

Arc Light Can Be Patented.

(9) Henry S. Fisher, Jr., Hoboken, N. J., sends in a plan and description of an electric arc light and wishes to know the commercial value of his invention.

(A.) The arc light shown seems to have some novel features and a search through our files has shown that nothing similar has been described or patented to the best of our knowledge. We feel quite sure that a patent can be obtained on this extremely novel invention.

We advise you to send your model and a full description at once to a good patent attorney in order to obtain a patent on the invention if possible.

As to the value of any kind of an invention this department cannot give such information because at best it is only pure guesswork. It is impossible for anyone to foretell what a given invention is worth. We might say $5,000 when an invention of this kind in the open market perhaps might not bring $500. Or if some manufacturer wanted it really bad he might pay quite a good deal more than $5,000. It depends entirely on how much a manufacturer or a corporation requires such a device and how much money they think they can make out of it. For that reason it is quite impossible to give any kind of a figure. At best it would only raise false hopes in the inventor's mind, and this department must therefore refrain from giving an opinion as to the commercial or money value of inventions submitted.

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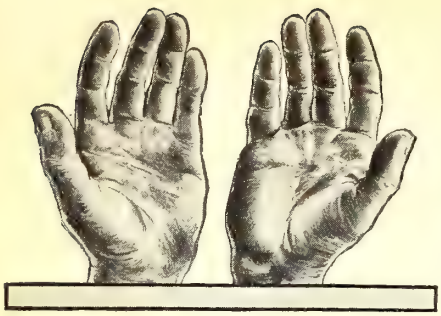
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QUESTION AND ANSWER DEPARTMENT.

(*Continued from page* 168.)

One of the best methods ever devised for the type of plant you speak of is that where the individual exciters are all operated on parallel to a pair of "common buses," all of the alternators then receive their field excitation current from these common exciting bus bars. You will thus see that it is a very simple matter to regulate the alternators by means of their field rheostats, and it is best also to have the exciter dynamos rigidly coupled together in some way if possible, so as to minimize the voltage fluctuations in them which would tend to cause one of them to take more of a load than it should, etc. In a great many modern plants the exciters comprise two D. C. dynamos driven by gears, from a single De Laval steam turbine. These two D. C. generators operate in parallel on a pair of common exciter supply buses.

A. 2. In regard to your question on figuring out the resistance and voltage drop in a circuit, etc., would say that if you will think over this matter you will undoubtedly see why both formulas you cite agree. You can prove this by simply taking a voltmeter and connecting same across any given resistance coil, etc., and you will find that the resistance of that particular unit is proportioned to the voltage drop. Therefore that resistance drop as indicated on voltmeter is divided by the current passing through the circuit, as indicated on an ammeter.

Ohm's law also, as you will remember, states that the resistance of a circuit in ohms is equal to the voltage required (or conjointly the voltage drop) to force a given current through the circuit. It is self-evident that the voltage required, in other words, is also the natural *voltage drop*

A. 3. We are not quite certain about your last query regarding calculations of the *average load current* in amperes from the factor of the known load in kilowatts, or whether you mean here the energy put out from the plant in kilowatt hours.

If you mean that the average load as indicated on a direct reading kilowatt meter of the switchboard type was 90 kilowatts during the two hours' run of the plant, then the average current would, of course, be deduced very readily by dividing the 90 kilowatts (or 90,000 watts) by the voltage; which would give you the average amperes load carried during the two hours' run.

BARON MÜNCHHAUSEN'S SCIENTIFIC ADVENTURES.

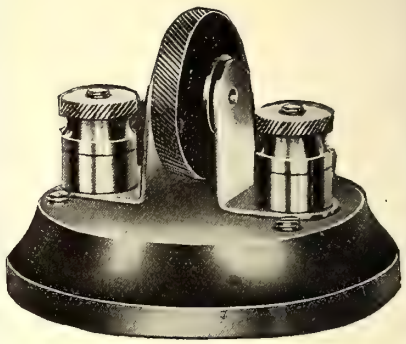
(*Continued from page* 137.)

stands out in a strong contrast against the inky sky. This pink fringe is not absolutely uniform in thickness; it is thickest near the earth's poles, thinnest near the equator. The difference in thickness is not very great, but quite perceptible. The explanation is that the terrestrial atmosphere, due to the centrifugal force produced by the earth's rapid rotation, tends to throw the air away from the equator. It is therefore forced to move toward the poles and as practically no centrifugal force exists there the air is naturally "thicker" here.

Another curious phenomenon is the position of the earth in the lunar sky. As seen from my present location (near the moon's equator) the earth is almost fixed in the heavens, i. e., it never sets or rises as does the moon when observed from the earth. But otherwise the earth for us goes through the same phases as does the moon for you. Thus during one month the earth

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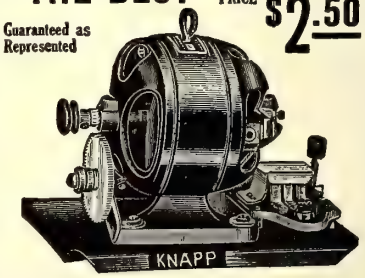
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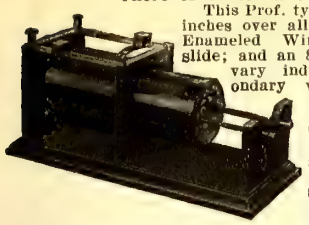
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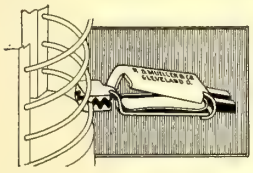
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changes from *new earth* to *first quarter,* then *full earth,* then *last quarter,* finally *new earth.* During these major phases we see the earth as a crescent, exactly as you see the moon as a crescent, only the earth crescent we see appears 14 times as large as the moon's crescent appears to you.

During *full earth,* however, we witness a spectacle that is truly wonderful to behold. As the earth rotates on its axis once in 24 hours, and inasmuch as the earth is fixed in the moon's sky, it follows that we must see the earth revolve before our very eyes. Nor do we have to strain our eyes to see the continents; everything is in plain view. As the lighted earth revolves in a black sky the contrast is extreme, impossible to describe. No such scene has ever been beheld from the earth.

The earth revolving from west to east, we see the continents moving from left to right. Thus, when the eastern shores of the American continents are first seen on the extreme left, it takes just three hours till the western shores come in full sight. In three more hours the broad Pacific Ocean and the Hawaiian Islands are directly in front of us, although they can only be seen as dots. Within four hours Japan, then the Philippines and the Australian continent have swung into view, while in four more hours all of Asia is spread before us, with India in the center, like a map. In three hours more eastern Europe, Arabia, as well as Africa, have appeared. Within two hours we see the rest of the European continent and western Africa; then follows Iceland and Greenland and below the Atlantic Ocean. Within five hours from the time western Europe disappeared on the right the eastern shores of the American continents appear once more. Thus we have seen all of the earth in exactly 24 hours—we have been "around" the earth in one day!

The waters of the oceans as seen from the moon appear to be a bluish-green, while the color of the Arctic oceans appears to vary from a pale green to a white. The white color is, of course, produced by the immense snow and ice fields of the Arctic. The color of the continents varies, of course, but the general appearance is a muddy yellow or red. Great plains and forests, as, for instance, those located on the American continents and Siberia show in a darkish green.

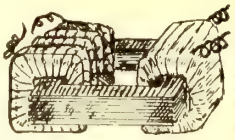
Nothing shows up very defined on land. One color merges into the other without showing abrupt breaks. The only lines which stand out tolerably strong are the shore lines, the great inland lakes and the islands. Even these lines do not stand out as strong as one might imagine. The reason for this is found in the earth's atmosphere. As the latter is ever moving, and as we have to look through 35 miles of it—an atmosphere not always clear—it follows that we can never see very sharp lines or markings on the earth.

When I said before that we can see the continents move plainly before our eyes it must, of course, be understood that large tracts are nearly always covered and hidden either by clouds, haze or fogs. Only in very rare instances can an entire continent be seen through its length and breadth, and since I am on the moon I have only seen it occur once, the continent in this instance being the American. Within one hour, however, large clouds had formed over a part of Central America, which became lost to all view within a short time.

With the naked eye, as seen from the moon, it is impossible to discern any object created by man's hands on the surface of the earth. Even large cities such as London and New York cannot be distinguished from the surrounding country. The reason

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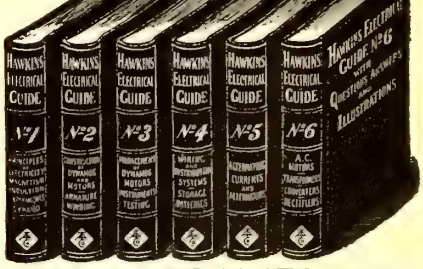
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is obvious, for it must not be forgotten that we look upon the top of the towns—the roofs—and the general color of these does not differ essentially from the streets and the surrounding grounds. For that reason the cities cannot be seen. If all the roofs and the streets were painted in white I am sure that the large towns could be seen, given a clear atmosphere. Thus, you observe, the earth as seen from the moon appears quite lifeless. Nothing is seen moving on it except the clouds; only in one instance have I seen anything out of the ordinary. This was a large forest fire in western America. Even then I could, of course, not see the fire itself, but only the vast, rolling quantities of black smoke were easily discernible. Other objects which can be made out when the weather is very clear on earth are the rivers; but only the larger ones, such as the Mississippi, the Amazon, the Nile, the Volga, etc., can be seen at all. We repeatedly tried to see long railroad tracks stretching across plains, but we have not been successful in locating them, even by the use of our powerful 3-inch telescope. The intervening distance—240,000 miles—is simply too great to see such fine objects. For this reason also some of the greatest achievements of man, such as the Panama and Suez canals, are entirely invisible to us, even with the assistance of our telescope

From the above it must become clear that comparatively small objects such as ships, trains, animals, etc., must forever remain invisible to us *Lunarians*.*

So much for the earth. As I mentioned before the stars appear much brighter on the moon than they do on earth. This again is due to the very thin lunar atmosphere. All the stars appear several times brighter to us than they do to you; furthermore, we can see with our naked eye stars such as are never seen on earth except with the aid of powerful telescopes.

The most inspiring view, however, is the milky way. It shines with a glory undreamed of on earth; its light is so powerful that objects around you become faintly visible in the dead black of our lunar night. The milky way does not appear to be as a weak blur, but it is well defined and we see myriads of stars invisible to the unaided eyes on earth.

There is one thing, however, of importance on the moon of which few people have any conception. I am referring to the meteors which are constantly raining on the surface of the moon. When such a meteor falls on the earth this is what happens:

A great mass of meteoric iron has come under the influence of the earth's attraction and is falling toward it at a speed of several thousand miles a minute. Until it reaches the outskirts of the earth it meets with no resistance, for it moves in the vacuum of universal space. The instant it penetrates the earth's atmosphere an enormous friction is produced between the meteor and the air, and the result is that the meteor becomes wholly or partly melted. Most of it volatilizes and goes up in smoke, to fall down subquently in the form of fine dust; only a comparatively small solid part reaches the earth, where it usually buries itself in the ground. Thus when we see a "shooting star" we see in reality a stream of fire produced by the melting of a meteor.

Now, the moon with its pitiful atmosphere affords no such protection as does the earth's atmosphere. Meteors crash about us with an alarming frequency. They come without any warning whatsoever. Some are as large as a watermelon and some as big as a small house. You can hardly imagine what happens when such a heavenly projectile, moving at the frightful speed of from 2,000 *to* 3,000 *miles a minute*, collides with the moon.

The noise of the impact is absolutely overwhelming. The crash of a cannon shot of a 15-inch gun is soft hand-clapping in comparison with it. The ground trembles violently for miles around, and if you are less than 500 yards from the scene one will usually be blown off his feet by the concussion, notwithstanding the very thin lunar air. If the meteor happens to strike a rocky or granite surface the result is even more awe inspiring. As a rule, in that case the whole meteor melts in an instant and goes up in a cloud of white-hot metal vapor. If you are near enough, say within one-half mile, the heat generated by the impact will become unsupportable for a short length of time, and within a few minutes exceedingly fine metallic dust will rain down upon you. It sometimes takes hours for this reddish dust to settle down.

Thus it can be imagined that it is rather dangerous to walk on the moon's surface. This is particularly true in November each year, when the earth and the moon pass through the meteoric "streams." At such a time I would not care to be present on the surface of the moon, and would prefer the lunar caves. Furthermore, I . . ."

Münchhausen did not finish his sentence. There was an abrupt, sharp click in my phones and the ether was ominously quiet once more. For some time I tried frantically to "raise" him, but in vain; he did not reply to me. I became highly alarmed about his safety. Had one of the meteors struck him and killed him? I could not tell. So I finally left my wireless laboratory with an uneasy feeling that everything was not quite right.

(*To be continued.*)

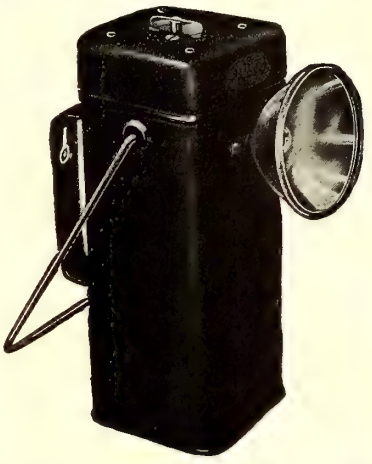
*Term applied to inhabitants of the moon.

TELEVISION OR THE PROJECTION OF PICTURES OVER A WIRE.

(*Continued from page* 132.)

tight structure, made up of a very large number of extremely small metallic cubes, which are all carefully insulated from one another, but, however, presenting a smooth, clean (metallic) surface to the cathode ray discharge on the one side and in contact with a suitable gas, as, for instance, sodium vapor, on the other. It is proposed to construct these screen "cubes" of some metal, like rubidium, which readily discharges negative electricity under the action of a ray of light, the negative charge being imparted to the cubes whenever the thin, pencil-like beam of the cathodic ray falls upon it. The receptacle "K" in the tube chamber is filled with some gas, such as sodium vapor, for the reason that such a gas conducts negative electricity far more readily under the influence of light than in the dark. A metallic screen of gauze, parallel to "J" in the tube is placed at "LL," and through this screen the image of the object at "N" is projected by means of the condensing lens "M," until after passing through the vapor of sodium it is eventually focused on the screen "J." The gauze screen "LL" is electrically connected through a line wire, as seen in Fig. 3, to the metallic diaphragm plate "O" in the receiver tube "A1."

Referring now to the receiving instrument, as indicated in our illustrations at Figs. 1 and 3, there is placed at the end of the Crooke's vacuum tube a fluorescent screen "H," and upon this screen, under certain conditions, which will be explained directly, the cathodic rays impinge, and certain parts of this screen are searched out every tenth of a second by the thin ray, under the combined action of the two A. C.

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electro-magnets "D'" and "E¹," which are placed similarly to the A. C. electro-magnets "D" and "E" at the transmitter station. As will be observed, the magnet coils "D" and "D'" are energized by the same A. C. dynamo "F" and also the A. C. magnet coils "E" and "E'" are excited by the alternator "G." It is therefore evident that the two magnetic-control circuits "D" and "D'" and "E" and "E'" and their resultants are therefore in perfect synchronism, i. e., their actions take place at the same time.

A Crooke's vacuum tube "A'" is used also at the receiving station as indicated, and its cathode electrode appears at "B¹." The disk of this electrode, which shoots forth the cathodic ray, is slightly inclined so as to project the ray at a downward angle, through the small opening "a'" in the anode electrode disk "C." Thus, under normal conditions, the cathode rays pass through opening "a¹," but they would be stopped by the diaphragm "P" and its centrally located orifice "S." They, in this case, are not brought under the deflecting action of the A. C. electro-magnets "D'" and "E'" and thus do not reach the image screen "H" before the observer at all. At "O" is a metallic circular disk, which is electrically connected with the screens "LL" at the *transmitter* instrument. Under ordinary conditions the cathode rays at the receiver cannot pass beyond the diaphragm "PS," but they can be made to do so, if slightly repelled by the lower diaphragm plate at "O." In this case, they will then fall on the screen "H" and cause *that part* on which they fall *to fluoresce* (i.e., light up).

Now assume that a uniform beam of cathode rays passes at marvelous velocity and without any appreciable inertia or mass in the tubes "A" and "A'" and that also the A. C. electro-magnets "D" and "E," "D'" and "E'" are energized, as previously explained. Also, suppose that the image of a person, for instance, appears at "N" before the tube "X"; this image is focused and projected through the lens "M," and through the gauze screen "LL" on to the back of the metallic screen "J," which, as will be remembered, is made up of a very large number of small metallic cubes. Then as the cathode rays in "A" oscillate under the combined action of the A. C. electro-magnets "D" and "E" they will cause a negative charge of electricity to be imparted in turn to all the metallic cubes, of which the screen "J" is composed. In the case of the shadows of the projected image, or considering those cubes on the screen on which no light falls, nothing will happen in the action of the apparatus, the charge dissipating itself in the tube. Therefore, in the case of those cubes on the screen which are brightly illuminated by the bright parts of the projected image, the negative electrical charge imparted to those cubes by the cathode rays will pass along, owing to the action of the sodium vapor, which is ionized under such circumstances, and so on until it reaches the gauze screen "LL," whence the charge will travel by the line wire to electrode "O" in the tube "A'" at the receiving instrument.

The plate at "O" will therefore become charged and will slightly repel the rays in the tube, with a result that they will thus be enabled to pass through the aperture at "S" and strike, for a fraction of a second, upon a minute portion of the screen, corresponding in position to the small cube surface on screen "J." This is possible, owing to the fact that the electro-magnets "D'" and "E'" are working in perfect synchonism or step, electrically, with the magnet coils "D" and "E" at the transmitter.

It will be understood, of course, from this description that this action will take place successively, but *not* simultaneously. In

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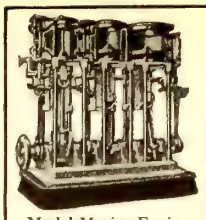
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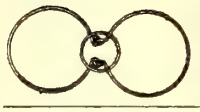


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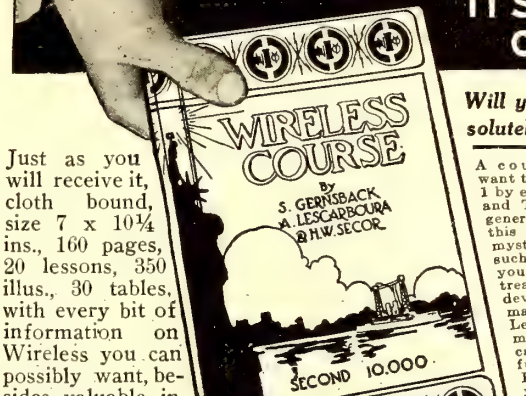
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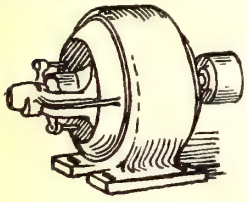
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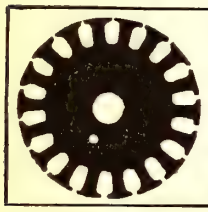


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other words, referring back to our previous discussion of how a picture can be built up out of black dots, etc., it is easily perceivable how this device could produce a picture if the illuminated spots on the screen are successively shown in a sufficiently rapid manner. In the case of our little metallic cube surfaces at "J," that are illuminated successively, there appear bright spots at simultaneous periods on screen "H" at the receiving instrument. These bright spots at "H" are of course to appear so quickly, and succeed one another so rapidly and smoothly, that the appearance they present to the eye will be one continuous picture.

It is quite conceivable that the apparatus of the future, which will enable us to see the party at the opposite end of a telephone line, for instance, may indeed work on this principle or a modified one. There is no other method which can work so rapidly and with so little inertia as this one utilizing the Crooke's tube, in which a cathode ray is caused to rapidly oscillate or be deflected through various angles in the same way as the Braun oscillograph tube is used for depicting radio-frequency wave forms. It was the Braun vacuum tube oscillograph that suggested the idea to Mr. Campbell-Swinton for this really ingenious *proposed method of perfecting a Television apparatus.* This is undoubtedly one of the most interesting fields for research work open to the experimenter of to-day.

NAVY TAKES OVER SAYVILLE RADIO

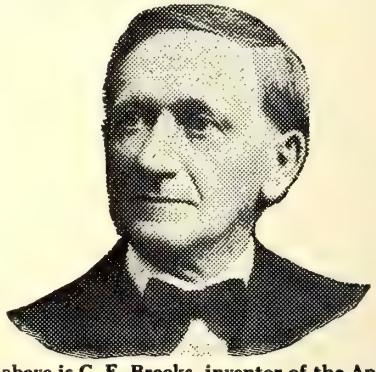
In the interests of American neutrality and to avoid contravention of the Hague Convention forbidding the establishment of belligerent wireless stations on neutral soil during a war, the United States Government refused to grant a license to the Atlantic Communication Company for the operation of the great German wireless station at Sayville, L. I., and took over the operation, management and control on July 9 last.

The Atlantic Communication Company claims to have committed no improper or unneutral act. Further it says: "No charge of any such act has been brought to the attention of its officers by any official of the United States. The Government censors on duty at the station have carefully supervised all messages sent, and have retained copies of the same. The company, being a public service corporation, had no discretion in refusing or accepting messages. As a matter of fact, the station, on account of static conditions, and also on account of lack of power, was unable during the summer months to communicate with Germany for more than one or two hours during the night. This difficulty will now be overcome by the operation of the new transmitter. Communication has been possible for the past few months only when it was night in Germany and night in the United States, which has been, as heretofore stated, only for one or two hours each night."

"And I want to add," Mr. Metz, president of the company, continued, "that as a result of the Federal action to-day we will be able to communicate with Berlin all the time, day and night, instead of an hour or two each day, as has been the case up to the present time. We will now for the first time be able to use the new plant, which is three times more powerful than the old plant, and that plant will be ready the 15th of this month. And, furthermore, there will be a reduction in rates. Instead of $1 a word plus the land rate the rate to Berlin will be 50 cents per word plus the land toll, while messages for Austria and Turkey will be 58 cents per word plus the land charges instead of $1.08 per word as is now the case.

BOOKS
Our New Book Catalog
has been delayed, but will be off the press on
August 15th, 1915
This catalog is particularly complete and up-to-date. Every book is illustrated and exactly described as to number of pages, size, bindings, illustrations, etc.
This valuable catalog will be sent on receipt of 2 cents to cover postage.
"BOOK DEPARTMENT,"
Experimenter Pub. Co., Inc.
233 Fulton St., New York

Don't Wear A Truss!
After Thirty Years' Experience I Have Produced an Appliance for Men, Women or Children That Cures Rupture.
I Send It On Trial.
If you have tried most everything else, come to me. Where others fail is where I have my greatest success. Send attached coupon today and I will send you free



The above is C. E. Brooks, inventor of the Appliance who cured himself and who is now giving others the benefit of his experience. If ruptured, write him today, at Marshall, Mich.

my illustrated book on Rupture and its cure, showing my Appliance and giving you prices and names of many people who have tried it and were cured. It gives instant relief when all others fail. Remember, I use no salves, no harness, no lies.
I send on trial to prove what I say is true. You are the judge and once having seen my illustrated book and read it you will be as enthusiastic as my hundreds of patients whose letters you can also read. Fill out free coupon below and mail today. It's well worth your time whether you try my Appliance or not.

FREE INFORMATION COUPON
Mr. C. E. Brooks,
1762 State St., Marshall, Mich.
Please send me by mail, in plain wrapper, your illustrated book and full information about your Appliance for the cure of rupture.
Name.....
Address.....
City.....State.....

Opportunity Exchange

YOU will probably find more opportunities and real bargains in these columns than anywhere else in the country. Most good things in life are hard to find and worth going after—these little ads illustrate that point; you alone will be the real loser if you don't take the time to scan through these columns.

Advertisements in this section 4c. a word for each insertion. Count 7 words per line.

Name and address must be included at the above rate. Cash should accompany all classified advertisements unless placed by an accredited advertising agency.

Ten per cent. discount for 6 issues, 20 per cent. discount for 12 issues from above rate. Objectionable or misleading advertisements not accepted.

Advertisements for the September issue should reach us not later than August 10th.

EXPERIMENTER PUBLISHING CO., INC., 233 Fulton Street, New York, N. Y.

BOOKS

360 POPULAR TOASTS. Selections suitable for all occasions; just what you need at an evening supper; 10c. "Km.," Wedge Manufacturing Co., Binghamton, N. Y.

HAVE YOU SEEN A COPY?—Amateur Photographer's Weekly, $1 per year; weekly prize competitions; criticisms; print exchange; illustrated; many features. Three months' subscription 25c. Amateur Photographer's Weekly, 915 Schofield Bldg., Cleveland, Ohio.

BICYCLES AND MOTORCYCLES

BARGAIN—$65 takes 1914 Flanders Motorcycle, nearly new; about $25 equipment. Paul Kohnke, General Delivery, South Chicago, Ill.

FOR Sale cheap. 1914 Harley-Davidson twin. Write for particulars. Walter Goerke, 321 Washington St., Newark, N. J.

1908 H. D. SINGLE with clutch and magneto, $30. 1910 H. D. battery model. A-1 condition, $35. 1911 H. D. single magneto model and clutch, $40. 1910 H. D. clutch and magneto, $45. 1 Indian motorcycle motor with magneto and Schebler carburetor, $25. 1 Excelsior motorcycle motor, $25. C. H. Lang, 1704 Michigan Ave., Chicago, Ill.

$50 TO $150 buys the best Motorcycles, every make and model in our large stock—must be cleared. Half price. Send for list to-day. Talking Machines, $5 and up. Brown Music Co., 9119 Commercial Ave., Chicago, Ill.

FORMULAS

MAKE Candy evenings; pays; receipt, 10c. Elmer Zimmerman, 1435 Walnut, Harrisburg, Pa.

ANY FORMULA WANTED—Sent for 20c. 3 Invisible Ink formulas, 25c. State requirements to Kelson Laboratory, Box 433, Elmwood, Ill.

SIX Valuable formulas for sympathetic inks, 50c. Wayne Thomas, Ithaca, N. Y.

FORMULAS for inks, black, blue, red, gold, green, silver, indelible, 15c each. 7 for $1.00. Stephen Rafferty, 2122 Arch St., Philadelphia, Pa.

CUTS anybody can make, 5c. Samples Stamp. Modern Engraving Co., Lynn, Mass.

MAGIC AND TRICKS

LOOK!! STOP!! LISTEN!!
"CHARLEY CHAPLIN PUZZLE."
The most interesting and amusing puzzle out. Send 10c. stamps or coin. Write to-day. Don't delay. Park Novelty Co., Dept. "A," 4233 Lake Park Ave., Chicago, Ill.

POST Cards, Tricks and Jokes, Coins, Notes, Stamps and curious things. Catalog for stamp. Coin Exchange, New Rochelle, N. Y.

BIG Catalogue. Magic, Entertainment goods free. Bates Co., Melrose, Mass.

MAGIC Tricks, Jokes and Puzzles. Trick with my catalogue, 10c. coin. H. V. Dils, Huntington, W. Va.

GREAT book wonders, secrets and mysteries and novelty catalogues, 10c. Wright Spec. Co. (D), Brewster, N. Y.

MAGIC tricks for the profession. Big catalogue and pocket trick free. Ventriloquial figures, $6.00 up. Magic Parlors, 192 Clifford, Providence, R. I.

NOVELTIES, Books, Tricks, Games, Etc. Illustrated catalogue free. Sample 25c. card trick, 10c. Auburn Supply Co., Specialty Dept., 7745 Peoria St., Chicago.

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Brooklyn, N. Y., April 15, 1915.

Gentlemen:—The results obtained from my advertisement in the "Electrical Experimenter" really surprised me; in fact the demand for a certain instrument of mine exceeds the capacity for manufacturing and it is all through the "E. E." To date, 79 inquiries, 12 orders. Might state last week filled a $50.00 order netting me a profit of $18.75. As to the exact value of my orders to date, I prefer not to give figures; however, you will always see my ad, month in and month out. I can truthfully say that the "E. E." has it on them all, viz., for quick results, interesting reading matter, etc. Very truly yours. HARRY Y. HIGGS.

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HELP WANTED

AGENTS—Build a business of your own with our Piano and Furniture Polish. Have used it in our shop successfully for five years. Send $1.00 for formula and trade secret. E. E. Lundberg School Piano Tuning, 143 N. Dearborn St., Chicago.

WANTED MEN AND WOMEN EVERYWHERE—Government jobs, $70.00 a month, short hours, vacations, rapid advancement, steady work; many appointments during summer and fall; common education sufficient; pull unnecessary. Franklin Institute, Dept. "A-120," Rochester, N. Y.

MODELS

MODELS made for inventors; general machine work; designing and perfecting; developing automatic devices and machinery; in a position to do all kinds of light tool and machine work. Prices reasonable; estimates cheerfully given. Ideal Machine Works, 62 Ann Street, New York City.

INVENTORS: We manufacture metal articles of all kinds to order. Also special machinery, tools and dies; punchings, lathe and screw machine work, metal spinnings, castings, plating, wood and metal patterns, etc. Send sample for estimate and expert advice, free. The Eagle Mfg. Co., Dept. B, Cincinnati, Ohio.

PRODUCERS of Results; Inventions Developed, Light Mfg., Models, Experimental Work, Tools, Dies and Stampings. Johns Machine & Stamping Works, Middle Bldg., Dept. C, Cleveland, Ohio.

MODELS, dies and manufacturing for inventors, by builders of "Tools That Work." La Croix Tool Co., 214 N. 21st St., St. Louis, Mo.

MISCELLANEOUS

PANAMA CANAL—For only 25c. will send you the great Panama Canal Telescope and a fine souvenir. Pacific Mail Order Co., 286 Second St., San Francisco, Cal.

THERE is but one Telegraph School that places all graduates direct in the Railway Telegraph service. It is Pelnars, Madison, Wis.

BLUE PRINTS AND BLUE PRINT PAPER. Hawes Blue Print Co., Wellesley, Mass.

MANSFIELD'S Electrical Water Finder is a thoroughly reliable appliance for locating positions for sinking wells for pure water supplies. Send for particulars to Mansfield & Co., Engineers, New Brighton, England.

MAIL ORDER OPPORTUNITIES

NOVELTIES—A complete line of a hundred different kinds of Tricks, Jokes, Magic and Puzzles for sale cheap. Also catalogues and stationery. A big chance for a hustler to start a big business. Only prospective buyers need answer. National Novelty Co., Box 225, Duluth, Minn.

PHOTOGRAPHIC

FILMS developed, all sizes, 10c. Prints, any size, 4c. each, 35c. per dozen; double weight paper used; needs no mounting; post cards same. E. H. Flowers, North Platte, Neb.

SPOT Cash paid for high-grade Kodaks, Lenses and Cameras. Send full description, stating lowest price. Cameras exchanged. In business since 1885. David Stern Co., Dept. M, 1047 W. Madison St., Chicago.

FILMS developed, 10c., all sizes. Prints 2¼x3¼, 3c.; 2½x4¼, 3½x3½, 3¼x4¼, 4c.; Post Cards, 50c doz. Work guaranteed and returned 24 hours after receiving. Postpaid. Send negatives for samples. Girard's Commercial Photo Shop, Holyoke, Mass.

EXPERT Kodak Finishing! Send for price list. Electric Studio, 162 Stephenson St., Freeport, Ill.

KODAK films developed. 5c., all sizes. Prints, 3c. each, any size. P. Johnson, 100 W. Bridge St., Oswego, N. Y.

PATENT ATTORNEYS

PATENTS without advance attorney's fees. Not due until patent allowed. Send sketch for free report. Books free. Frank Fuller, Washington, D. C.

PATENTS SECURED OR FEE RETURNED. Send sketch or model for free search and report. Latest complete patent book free. George P. Kimmel, 254 Barrister Bldg., Washington, D. C.

DRAWINGS made for inventors. Consulting Engineer, EE-3240 Seminary Ave., Chicago.

STAMPS AND COINS

STAMP Album with 538 Genuine Stamps, incl. Rhodesia, Congo (tiger), China (dragon), Tasmania (landscape), Jamaica (waterfalls), etc., 10c. 100 diff. Jap., N. Zld. etc., 5c. Big list; coupons, etc. Free. We buy stamps. Hussman Stamp Co., St. Louis, Mo.

GET the most out of your money you can. Try my 1, 2 and 3-cent approvals and you'll be pleased. References required. Wm. Haase, 971 E. 39th St., Los Angeles, Cal.

STAMPS, 100, ALL DIFFERENT, FREE—Postage 2c. Mention paper. Quaker Stamp Co., Toledo, Ohio.

FOREIGN Stamps Free, 52 different foreign, including China and Venezuela, to all who apply for our high grade approval selections. Send two cent stamp for return postage. Edgewood Stamp Co., Dept. H, Milford, Conn.

WIRELESS

EXCEPTIONAL Radio Apparatus. A 2c. stamp will bring my literature. H. Y. Higgs, 30 Irving Pl., Brooklyn, N. Y.

WIRELESS receiving set and other instruments for sale. Howard Sorey, Newkirk, Okla.

TUNER—A fine bare wound double Slide Tuner for only $1.75, postpaid. It is made of vulcanite and is a dandy instrument. Send a 2c. stamp for my lists. Carl Rhapstock, Plainfield, Wis.

FOR SALE—Hot Wire Ammeters; two readings, Aluminum casing with bracket; complete except dials; guaranteed. L. R. Jewett, 200 Lewis St., Lynn, Mass.

WE make Loose Coupler, 2,500 meter, $5; Tuning Coils, 350 meter, $2. Cliff Mfg. Co., Box 130, Brookfield, Mass.

AUDION Amplifier Hook-up. Marvelous! Uses one Audion only; Wireless Arcs, any size, Poulsen or Collins type; Inductance capacity, Wave length, Chart; Blueprints either one, 20c. H. Winfield Secor, Consulting Engineer, 2040 7th Ave., New York City.

Scientific Exchange Columns

UNDOUBTEDLY you have at the present time some things for which you have no further use. Do you wish to sell these things or exchange them for something, for which you have immediate use? There is no surer and quicker way to do this than by advertising your articles in these columns. The **Very** people, the **Only** people, who could possibly have a use for your things read this journal. More than 30,000 interested people will see your ad. It is furthermore the cheapest advertising medium for you in the country.

The rates are: One cent per word (name and address to be counted) minimum space 3 lines. Count about 7 words to the line. **Remittance must accompany all orders.**

We reserve to ourselves the right to refuse any advertisement which we consider misleading or objectionable. Advertisements for the September issue should reach us not later than August 10th.

The Classified Columns of "The Electrical Experimenter" Bring Positive Results.

FOR SALE—One Colby Tuner. Tunes up to 600 or 4,000 wave meters, for $3.75. Raymond Clapp, Groton, New York.

EXCHANGE—An Omnigraph and books on telegraphy and electricity for disc phonograph. J. M. Keating, 8 West Center St., Beacon, N. Y.

FOR SALE AT A BARGAIN—Medium size wireless outfit consisting of a good loose coupler, Electro loading coil and a junior fixed condenser wired on oak base. Weight five lbs. Price $5.00. John L. Miller, 1451 Grant St., Marinette, Wis.

FOR EXCHANGE OR SALE—A complete wireless sending and receiving outfit that cost $35.00. Send 2c. stamp for a complete list of instruments. Philip Ash, 3009 Greenwood Ave., Louisville, Ky.

FOR SALE—Blitzen receiving transformer. Good as new. Cost $15; will sell for $10. John H. Widmyer, 1 S. Duke St., Lancaster, Pa.

FOR SALE OR EXCHANGE—$1.25-Pocket Voltammeter-75c.; 2-One Dollar 1½-Pint Leyden Jars-One Dollar; 60c. Zinc Spark Gap—30c; 35c. Telegraph Key—25c. Articles are all E. I. Co.'s goods. What do you offer in exchange? Louis Menier, 29 West 39th Street, Room 808, New York.

FOR SALE—Pony Telephone Receiver; Automatic Transmitter; Newspaper Correspondence Course; "The Minister and The Community," by Woodrow Wilson; 6-volt 14 candlepower bulb and socket—Insect Mount—Dividers—Metronome. Mark Kistler, Centerport, Pa.

ELECTRICAL—35 K.W. Westinghouse Alternator, right for a small town plant, $300 in payments of $20 per month. 18 K.W. 220 volt direct current generator will carry 900 regular 16 candle Tungsten lamps, $200 in payments of $15 per month. 16 cells storage battery in good condition $35. Electric Bath Cabinet $25. Box M, Troy, Ohio.

TO TRADE—Small D. C. Motor, cost $14, for Wireless goods; ¼ K.W. Transformer or Loose Coupler preferred. Lenden Enloe, Eldorado Springs, Mo.

WILL EXCHANGE—A complete three year law course, also a number of electrical, chemical and mechanical text-books for laboratory apparatus or other text-books. What have you? Wm. E. Brady, 1569 Lauderdale Ave., Lakewood, O.

A GOOD Victrola wanted in exchange for some first-class wireless and electrical goods that I have for exchange. Write for complete list of goods. Charles Steck, 235 Third St., Union Hill, N. J.

FOR EXCHANGE—Electro Wireless course, 1 K.W. sending set, commercial Perikon; $5.00 set of receivers, $10.00 worth of piano music, 500 new view postals, $10.00 worth of assorted switches, $15.00 portable receiving set, $10.00 sending set, Kodak developing machine, Static machine, 6 volt 80 amp. storage battery; $10.00 powerful motor. Would like 3A folding Kodak or other articles outside of Wireless line. Charles Steck, 235 Third St., Union Hill, N. J.

TO SWAP—A College Tennis Racket and fielder's D. & M. glove for Phonograph Spring Motor and a Phonograph Needle Holder. George W. Sutherland, Jr., Suffern, N. Y.

BUY—I want to buy some good electrical books in good condition. Example: "Experimental Wireless Stations," by Philip E. Edelman, etc. Please send list with full description of each book. Will exchange apparatus. Walter Franseen, Woodhull, Ill.

WANTED—At once second-hand 2-inch Spark coil. Must be cheap and in perfect condition. Will pay cash. Lloyd Stratton, 44 Seneca St., Oneida, N. Y.

BARGAIN—3,000 Meter loose-coupler, primary 5 inches long, 4½ inches diameter; secondary 5 inches long, 3¾ inches diameter; 10 taps. Good make and brand new. First money order for $4.00 takes it. Have Murdock fixed condenser in perfect condition; cost $1.00, will sell for $.65. Russell Pyles, 4 West Melrose St., Chevy Chase, Md.

FOR SALE—¼ H.P. steam engine with boiler and shafting ready to run, dynamo, emery wheel, etc., $5.00; Knapp 9 volt dynamo motor, $2.50; two telegraphs, $1.00 each; 2 lbs. No. 32 brand new magnet wire, $1.00; $10 American typewriter, $4.00. George R. Mapstone, Aurora, N. Y.

3100 Broadway, New York City,
5-29-'15.

Gentlemen:—

It may interest you to know that in answer to my advertisement in your Scientific Exchange columns, I have received to date fourteen answers, selling instruments to second inquirer. Either your paper is extra good or my price was too low.

HAROLD B. ADAMS.

EXHANGE—Years '13 and '14 Popular Mechanics, aerial wire, small electric engine. What am I offered? W. A. Mattise, 402 Eddy St., Ithaca, N. Y.

FOR SALE—Large variety of books, electrical magazines, one set New Method Scientific books, together with other good bargains. Write for complete list. Sherman Johnson, Sidney, O.

I HAVE an A No. 1 Wireless that I will trade for a Gasoline Engine or a Motorcycle. Answer at once. Hubert Henneberger, P. O. Box 105, Hagerstown, Md.

POTENTIOMETER for sale cheap; never been used. Write for particulars. Adrian Kishpaugh, Newton, N. J.

FOR SALE—Receiving set, good as new, 60 per cent. less than list price. Box No. 1, Wamesit, Mass.

FOR SALE OR EXCHANGE—Electrolytic and galena detectors, camera with portrait attachment, shocking machine, battery motor, Simplex typewriter and wireless books. Benj. F. Kinnick, Jr., Greenwood, Ind.

EXCHANGE—Loose Coupler, Loading Coil, Peroxide of Lead Detector, Potentiometer, factory made. Want 3,000 ohm phones or Cabinet 3,000 metre Loose Coupler. W. T. Gravely, Box 245, Danville, Va.

MAKE cash offer for new No. 2 Omnigraph, 15 dials, cost $14.00. Will trade Spaulding best double end punching bag and Reach football cover for wireless phones. Kenneth King, Talent, Ore.

FOR SALE—Slightly used wireless instruments; No. 9950 Tuner, $1.50; Sliding plate condenser, $1.50; No. 10000 fixed condenser, 50c.; No. 9250 potentiometer, 50c.; No. 8090 phones, $2.00; ¾ inch spark coil, $2.50; No. 9002 detector, 75c.; No. 9260 sending condenser, $1.75. Edgar Purdon, Vanceburg, Ky.

FOR SALE OR EXCHANGE—One inch Spark Coil, good as new; gives 1¼ inch spark on 8 volts A. C.; Wireless Key on fiber base. Write for prices or offers. Donald Rockwell, Wellsboro, Pa.

FOR SALE—$10.00 Erector Set, $4.00; $1.25 Franco Tubular Flashlight, with 3 cell battery, 75c.; Beacon Fountain-light, 50c. All good as new. Bertram Smith, Spring Valley, N. Y.

FOR SALE—Two in one Spark plug and a coil for motor boats; good as new. Will sell for $4.00. R. J. Freeman, Aloah Radio Station, Southampton, N. Y.

HAVE battery motor, weight 9 lbs. Will exchange for E. I. Co. amateur wireless 2,000 ohm headset. Forest Monroe, 1153 Te Walt St., Vincennes, Ind.

WILL sell omnigraph No. 2 Junior for $5.00, prepaid; cost $9.00. Used only a short time. William E. Youngs, Sears, Mich.

WILL SELL OR EXCHANGE for wireless goods one miniature electric railway outfit, in perfect condition. J. P. Rickman, Pinckney St., Greenville, S. C.

PART OF A WIRELESS OUTFIT, INCLUDING LATEST INVENTIONS. L. J. Becker, 2924 Ave. L, Galveston, Tex.

FOR SALE—Mesco ¾ inch Spark Coil and Single-Slide Tuner, perfect condition; Glass Transmission Condensers. Write for particulars. R. J. Liedel, 28½ Warren St., Providence, R. I.

FOR SALE—A Bunnell 43 plate rotary variable condenser, $2.50; a Mignon Vario Selective Coupler, $4.00; E. I. Co. Radioson detector, $3.00; $8.00 takes them all. These instruments are all practically new. Write George D. Todd, Jr., New Albany, Ind.

FOR SALE OR TRADE—Nearly 3 lbs. of aluminum wire. R. B. Wann, Calumet, Ia.

FOR SALE—One Loose Coupler, $2.50; one 5 bar Generator, $3.50; both for $5.50. George Goodrich, Green Cove Springs, Fla.

FOR SALE—Electric books, apparatus and tools for less than half price. Send for list. Also want to buy motorcycle engine. Alex Sesna, Lehigh, Okla.

USE flaked paraffine to paraffine paper for condensers; 2 cents an ounce, postpaid. Send stamp for sample. Shelby Blong, Hawthorne, Cal.

FOR SALE—One 1½ inch spark coil minus vibrator and condenser, home-made loose coupler and step-down transformer. Waldemar Vanselow, 310 Coolidge Ave., Syracuse, N. Y.

FOR SALE—Peroxide of Lead Detector and Potentiometer, $1.50; Galena Detector, 50c.; Variable Fixed Condenser, 75c.; Fixed Condenser, 25c.; 700 Meter Tuning Coil, $1.75; 1,000 ohm Receiver and cord, $1.50; High Frequency Buzzer, 45c.; 600 feet Aerial Wire and 12 insulators, $1.50; 2 Switches, 25c. Leighton Gilbert, Bristol, N. Y.

FOR SALE OR EXCHANGE—One $4.00 variable condenser, $3.00; one $1.50 brass ribbon helix, $1.00; both new; E. I. make. Will exchange for Audion bulb. V. C. McIlvaine, Tampa, Fla.

FOR SALE—Kohlert Clarinet, Bb, low pitch, 13 keys, two rings. New condition. Absolutely O. K. Rollinson self-instructor. C. O. D. mail $8.50. Roy Linnard, Peotone, Ill.

FOUR first-class Perikon Detectors complete; also cat whisker stands, fully adjustable. Want large variable condenser Clapp Eastham make. Furman, 5528 Echo St., Los Angeles, Cal.

FOR SALE—$6.00 receiving transformer, $10.00 magneto, $5.00 32 cal. revolver and a $2.75 spark coil; $9.00 takes the entire lot, or will exchange all the articles for a navy type receiving transformer and a pair of transatlantic phones. Will not sell or exchange any of the articles separately. Address Herbert Ewing, Point Marion, Pa.

FOR SALE—Clapp-Eastham Ferron Detector, $2.50; Fixed Condenser, 50c.; 32 cal. Target Revolver, 5 inch barrel, $4.00; King Folding Boat, $10.00. All sorts photographic bargains. Send for complete list. H. E. Davies, Jr., Vineyard Haven, Mass.

WANT TO SWAP? Join my exchange bureau. Send a postal for particulars. The Eureka Exchange Bureau, 283 Sackville St., Toronto, Can.

WANTED—Small Steam Model Boilers, also Engines, Marine, or any design, together or separate. No toys. State full particulars and price. F. Daniel, 116 West 42d St., New York.

WANTED—Brandes Superior Headset, Loose Coupler, 2 or 3 inch Spark Coil or any Wireless or Electric goods. Have a 6 volt 6 ampere Dynamo for sale, or will trade for any of above. State what you have. Miles Hart, Somers, Conn.

HAVE for sale or exchange 3,000 meter Loose Coupler and a fine 1½ inch Spark Coil. Leo B. Wilcox, Angola, Ind.

FOR SALE—E. I. 8060 Transformer coil, $4.00; Gernsback interrupter, $1.00; two Murdock moulded sending condensers, $2.75; 3½ inch Kodak film tank, $2.50; Knapp 6 volt dynamo, $2.00; Electric moving picture and lantern slide machine, $5.00; Electric question board, $1.00. Write for particulars. Raymond Schlegel, 1118 North Negley Ave., Pittsburgh, Pa.

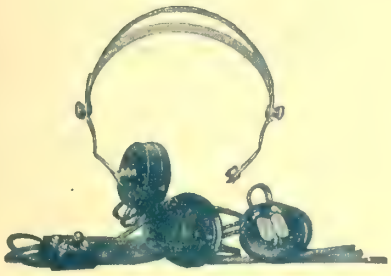
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Complete
Double 2000 Ohm Set
only $4.00

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only $5.00

Either Set With Coronet Band, $ .50 Additional



With Regular Band.



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FOURTEEN DAYS TRIAL ALLOWED

MONEY BACK IF THEY DON'T MAKE GOOD FOR *YOU* IN *YOUR* STATION. ORDER A SET TODAY. ASK FOR "SPECIAL No. 55."

Our new catalog of really good apparatus is ready. Your request for a copy will introduce you to the finest line of reasonably priced apparatus on the market.

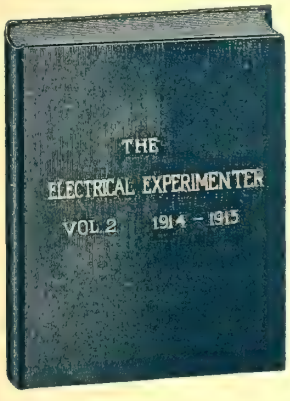
680 HOWARD ST.,
SAN FRANCISCO, CAL.

WM. J. MURDOCK CO., 55 Carter St., Chelsea, Mass.

STOP!

We hereby present one of the greatest bargains in electrical literature ever offered.

A complete Volume of the *Electrical Experimenter*, bound in rich, dark green linen, stamped with gold letters at the extraordinary low price of



75c.

Volume contains twelve numbers (from May, 1914, to April, 1915), **240** pages, **350** complete articles, **550** illustrations, **396** questions and answers.

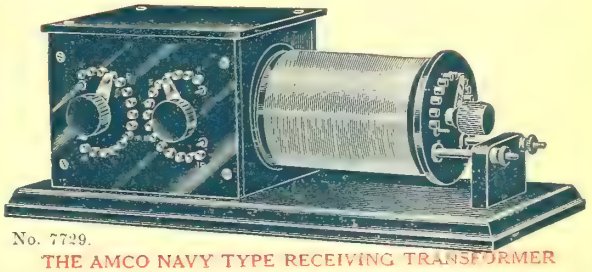
A world of electrical information; the entire electrical Progress for one year; the greatest reference book on current "Wireless"—all at a price as low as the *unbound* copies would bring. Mind you, the book is durably bound with heavy covers. You will be proud to have it in your library. We have only a few hundred copies, therefore be sure and order today. Shipping weight 2 lbs. Add a sufficient amount for postage.

EXPERIMENTER PUB. CO., Inc.
BOOK DEPARTMENT
233 Fulton Street, New York

August Bargains

OUR NEW BIG 216 PP. ELECTRICAL AND WIRELESS CATALOG IS THE EXPERIMENTER'S REFERENCE BOOK

THE BEST BARGAIN IN THIS MAGAZINE IS



No. 7729.

THE AMCO NAVY TYPE RECEIVING TRANSFORMER

Represents the latest advances made towards the ideal tuner and embodies the greatest degree of perfection yet obtained. No greater value can be secured where accurate selectivity, sensitiveness and finish are desirable. The illustration shown herewith cannot possibly do justice to the instrument itself. The primary winding is enclosed in a cabinet, the sides and top of which are polished hard rubber. Two 15-point switches are mounted on the front. One switch controls the primary in groups of several turns and the other controls one turn at a time. The entire variation of the primary is thus secured by the rotary motion of two knurled knobs rather than the movement of a slider, and may be varied from **1 to 225 turns in steps of one turn at a time.** The windings are especially adapted to long wave lengths. The secondary is wound with green silk covered wire. The ends are HARD RUBBER, turned and polished. Secondary variation is secured by a 12-point switch which makes it possible to secure a very fine adjustment.

PRICE, ONLY $15.00

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Complete description and prices of the latest Electrical and Experimental Apparatus—Storage Batteries, Rectifiers, Transformers, Induction Coils, Wireless Apparatus, Lamps, Flashlights, Meters, X-Rays, Books, Tools, Electric Railways, Steam Engines, Water Motors, Dynamos, Motors, Telegraphs, Telephones, Electrical Supplies, Model Aeroplanes and Parts for building your own apparatus. A Treatise on Wireless Telegraphy, telling how to put up an aerial, connect apparatus, together with a Call list and Wiring Diagram, FREE with every catalog. 6c. in stamps will bring you this wonderful book. The best catalog of wireless apparatus, etc., published.

ADAMS-MORGAN CO. 13 ALVIN PLACE, **Upper Montclair, N.J.**

August Bargains

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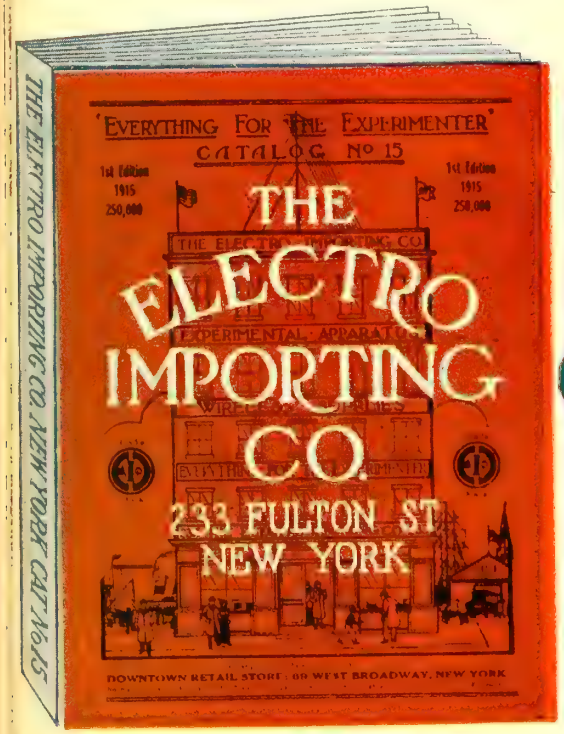
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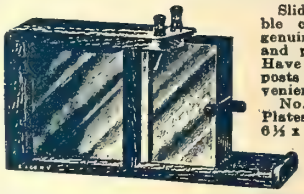
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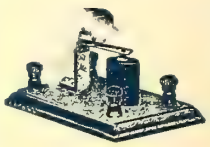
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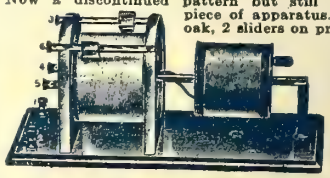
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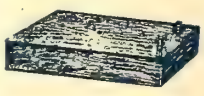
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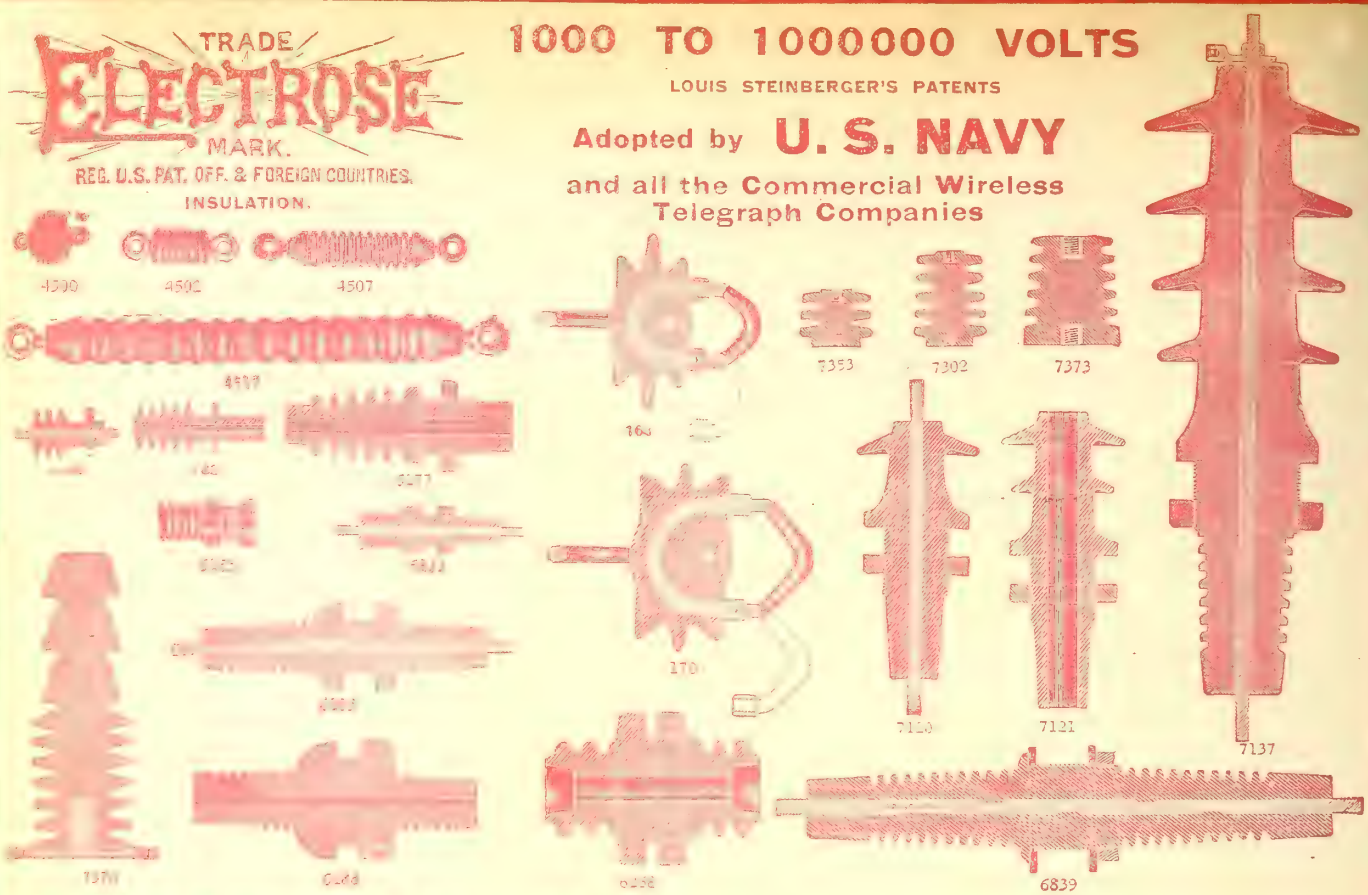
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Vol. III Whole No. 29 CONTENTS FOR SEPTEMBER, 1915 No. 5

FRONT COVER—"THE WIRELESS TORPEDO"..... From a Painting by Thomas N. Wrenn —
THE WONDERS OF "RADIUM"..... 179
COMBATING THE SUBMARINE BY ELECTRICAL MEANS..... By H. Winfield Secor, E.E. 184
RUBBER PRODUCED ARTIFICIALLY BY ELECTRICITY..... By Frank C. Perkins 185
NEW LOUD TALKING TELEPHONES USED BY THEATERS.... 186
SOME LATE THEORIES FOR THE YOUNG SCIENTIST..... By Rogers S. Rusk 187
"OMEGON" (A Scientific Story)....By George Frederick Stratton 188-190
THE OLD "BUG" SPEAKS.....By Thomas Reid 191
"THE WRAITH OF THE WIRELESS"..Poem by Rose Seelye Miller 192
LUNA PARK, NEW YORK'S "JOYLAND"..... 193
LONG DISTANCE SUBMARINE TELEGRAPHY AND TELEPHONY 194
ELECTRIC PONY SHOOTS SPARKS..... 194
ENAMELED MAGNET WIRE, ITS PROPERTIES AND MANUFACTURE .....By L. Earl Deane 195
NEW THERMO-RELAY FOR MOTOR PROTECTION..... 196
NEW COMPACT RESISTANCE UNIT..... 196
ELECTRIC ILLUSION SIGN FOR BARBERS..... 196
X-RAY TUBES AND THEIR MANUFACTURE..By Samuel Cohen 197
THE STATIC MACHINE, PAST AND PRESENT..... 198
WHEN EDISON GOT MARRIED..... 199
NEW CALORIMETER REGISTERS ENERGY OF MAN'S EVERY MOVE..... 200
NEW ENGLISH WATER OZONIZER..... 201
EDISON HEADS NEW U. S. NAVAL ADVISORY BOARD..... 201
THE WIRELESS TORPEDO IN THE "MOVIES"..... 201
SELENIUM CELLS AND RADIO TORPEDOES..... 202
HOW TELEPHONE TRANSMITTERS AND RECEIVERS ARE MADE—(Concluded) 203
WAR AFFECTS CHANGE IN DRY CELLS..... 204
"THE CONSTRUCTOR" DEPARTMENT.....205-208
"WIRELESS" DEPARTMENT.....209-217
WHY "SAYVILLE" RADIO STATION WAS CLOSED..... 210
THE HAMMOND RADIO CONTROLLED TORPEDO BOAT..... 211
EUROPEAN APPLICATIONS OF WIRELESS TELEPHONY..... By Frank C. Perkins 212
SOME REMARKABLE RESULTS WITH AUDION AMPLIFIERS. By John A. Gardner and E. R. Isaak 214-215
"HOW-TO-MAKE-IT" DEPARTMENT..... 218
WRINKLES-RECIPES-FORMULAS 221
"AMONG THE AMATEURS".....222-223
LATEST PATENTS 224
"PHONEY" PATENTS. 225
QUESTION BOX 226
PATENT ADVICE.....By H. Gernsback 231-232

Uncle Sam and the Inventor

AT last the American inventor is coming into his own. Our Government, which heretofore has paid but scant attention to the activities of our inventors and experimenters, is beginning to recognize that there are a few persons outside of the Department who know a thing or two.

The courageous action of Secretary of War Daniels in organizing a board composed of the foremost American inventors cannot be lauded too highly. Mr. Edison has already accepted enthusiastically Mr. Daniels' invitation as chairman of the new Advisory Board, and no doubt we will soon witness valuable additions in the persons of famous inventors like Orville Wright, Henry Ford, John Hays Hammond, Jr., Tesla, Bell, Steinmetz and others.

This board of famous civilian experimenters will be known as the *Naval Advisory Board* and will have the sole purpose of strengthening our weak national defenses by means of new inventions. The European war has amply shown that battles are no longer won by means of men and guns alone. Never before have scientists won as many battles as now; never before have battles been so deadly as now, due entirely to science let loose on the enemy. As Secretary Daniels states:

"One chemist, one electrician might be greater in the warfare of the future than Napoleon, at his best, was in the warfare of the past. One scientist very probably may do more for the United States than any admiral or general could do."

Frightful? Of course. What otherwise can be expected of poisonous gases, electrically charged wires, land and sea mines, bomb-throwing aeroplanes, murderous submarines, and poisonous shells? But then, all warfare is frightful. Once you have been killed, it does not matter whether the ancient sword of a Roman pierced your heart or a modern poisonous gas snuffed out your life. The sole business of war is to kill, and the more frightful and the more terrible our scientists can make war, the better for us.

For it must not be forgotten that, once we arrive at a stage where we are able to annihilate a whole regiment at one stroke, there will be no more wars. People will then think for a long time before engaging in foolish wars, and once people begin to coolly consider, the danger of war is well nigh passed.

As a democratic nation we do not believe in a big standing army, indeed the more the world advances in scientific warfare, the less men do we need to defend a given line. Already the common soldier with his rifle is an anachronism. His rifle is of but little use to him to-day and is fast disappearing. Two men behind a machine gun can hold 500 soldiers with rifles at bay with ease, while in trench warfare the rifle becomes an actual hindrance. Future wars will be machines against machines, far more so than to-day, while the common soldier of the present will man the machines. Land battles will be fought so far apart that men will no longer be able to see each other, as is the case in the present naval warfare, where the battling dreadnoughts are actually shelling each other with nothing but their mastheads showing above the horizon.

Undoubtedly many an American inventor has been bitterly disappointed in the past for not having his invention recognized, or else not having the means, financial or otherwise, to try out his idea in actual practise. This the new board will remedy. The poorest inventor with a good idea will now have his chance to submit it to a board of men who are not to be influenced in the slightest by financial or other considerations. He will get frank and expert advice, which he probably could not obtain anywhere else in the world—and the advice will not cost him a single penny. If his idea is good, he will be told so. If it is not good, he will know that he is on the wrong track, for the men that tell him so are not theorizers, but practical inventors and experimenters, whose opinions can safely be relied upon in all cases.

It behooves us to applaud Secretary Daniels for his momentous innovation and we furthermore sincerely hope that American genius will succeed in making wars so terribly frightful and so deadly that there will not be a "next war."

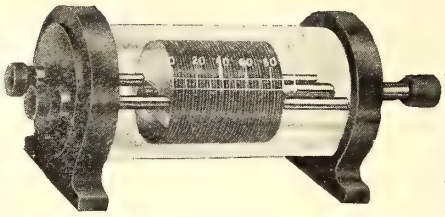
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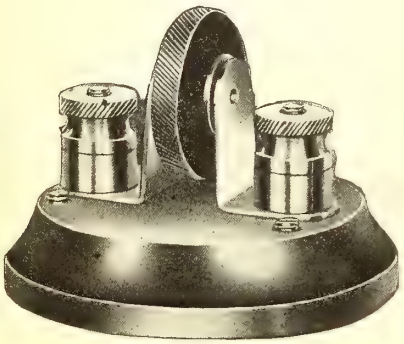


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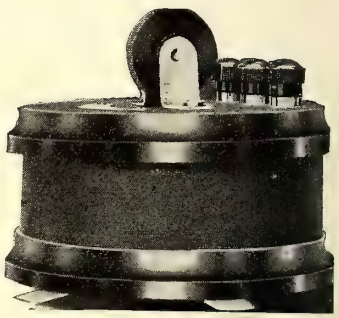
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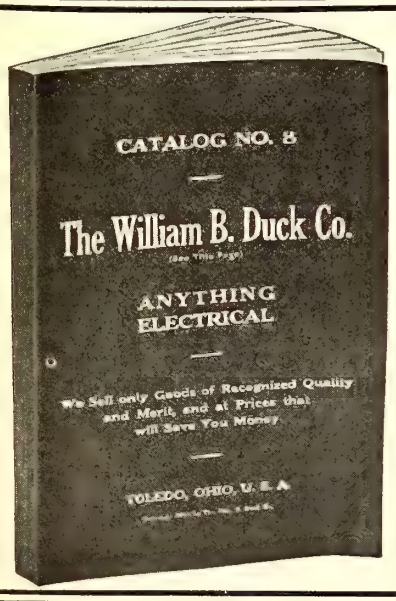
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The Wonders of Radium

RADIUM! A thousand years hence a benevolent smile will pass over the features of the average planet inhabitant when he thinks back upon the time when science was still grappling with the mysteries of Radium, the wondrous. It will no doubt seem strange to him how the world could have gotten along for centuries without having subjugated nature's forces to his entire advantage, as he will do then. He will pity us for having lived in a dark age, and his pity for us will be on par with that we now have for the Dark Ages, when man still made the cave his abode.

We are accustomed to think of electricity as being a wonderful power. Indeed, it has revolutionized our lives completely. It might be said that up to the 19th century, that is, before the advent of electricity, man was still uncivilized. We might even go so far as saying that the new civilization period dates back to the year 1791, when Galvani first made his memorable experiment with the frog, incidentally discovering "Galvanic" electricity.

But the wonders of electricity, as we are accustomed to them to-day, are naught when we contemplate the marvels that lay before us when man will finally understand atomic forces. Every particle of matter has concealed within itself undreamt of forces which at present are locked up and are inaccessible to man. Once we are enabled to unlock these forces, the proverbial "Aladdin's Lamp" will grow pale by comparison.

Is Radium the key that will open the door to the Promised Land? What is Radium? What are its functions? Wherein does it differ from a piece of stone? The average man does not seem to know; indeed, it is amazing to find how much ignorance there is displayed at this minute as to what Radium really is and does. The layman has the most astonishing conception about this wonderful element, and the wildest prophecies and guesses are made by people who have a good general knowledge of everyday science.

The purpose of this article is to set forth in a popular manner the wonders and the astounding possibilities of Radium in a non-technical manner as far as that is possible.

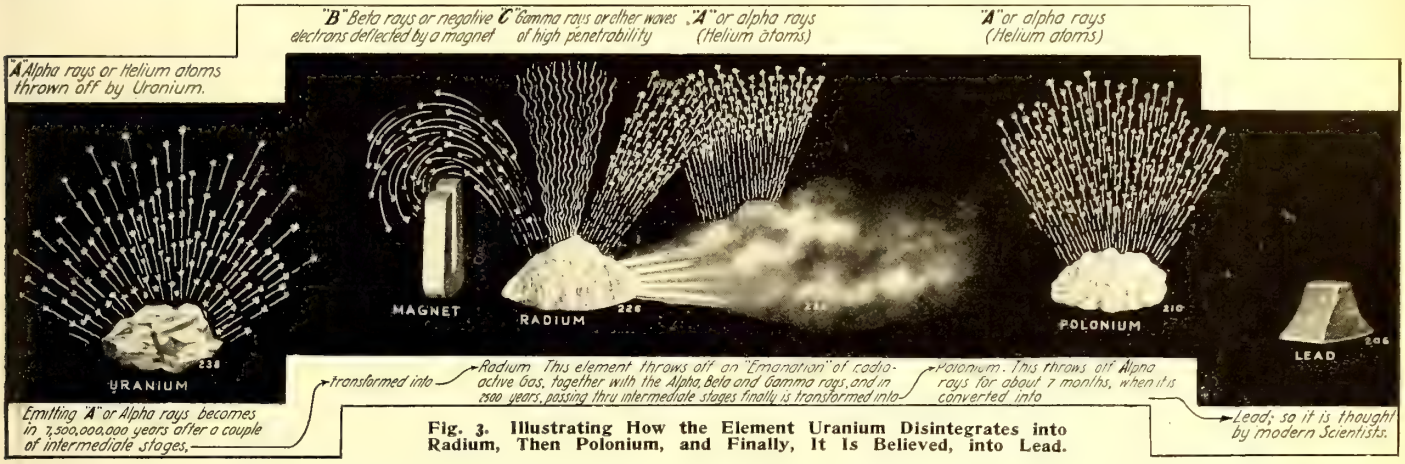


Fig. 3. Illustrating How the Element Uranium Disintegrates into Radium, Then Polonium, and Finally, It Is Believed, into Lead.

IN this prosaic age we are prone to scoff at miracles; we only think of them as the foolish misconceptions of a bygone age. But the most impossible miracles of the past pale into insignificance alongside of Radium, the miraculous. Who could have predicted 20 years ago that 1/50 gram of a new element—Radium—could supply sufficient energy to lift the Woolworth building bodily into the air? Where is the bold prophet who can predict the still greater miracles in store for man? Radium is the key that will open the door to man's final emancipation. This article explains its wonders in a non-technical manner.

History of Radium.

Prof. Henri Becquerel, the famous French physicist, in 1896, while experimenting with the then newly discovered X-rays, wondered if it were not possible to procure a substance that would give off rays similar to X-rays. After numerous and painstaking experiments, he found that his surmise was correct, and he found that the element Uranium was indeed capable of giving forth rays similar to X-rays, without in any way being under the influence or connected to any electrical or other source of power. In other words, he found that Uranium gave off a spontaneous and continuous stream of rays, without seemingly disintegrating while it was doing so. A homely comparison will not be amiss here.

Suppose we have an automobile tire well compressed with air. It would be reasoned that in case of a minute puncture the air

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will leak out quickly, the tire becoming flat, after the accumulated air has left it. This is a comparison of the X-ray, i. e., the X-ray tube gives forth X-rays only as long as it is connected to an electric transformer. Now, Uranium acts like a tire that has a puncture, but notwithstanding this it does not become "empty." Of course Uranium, the same as any other natural force, will "give out" finally, but it has been calculated that it will take some 7,500,000,000 years before it ceases to be "active."

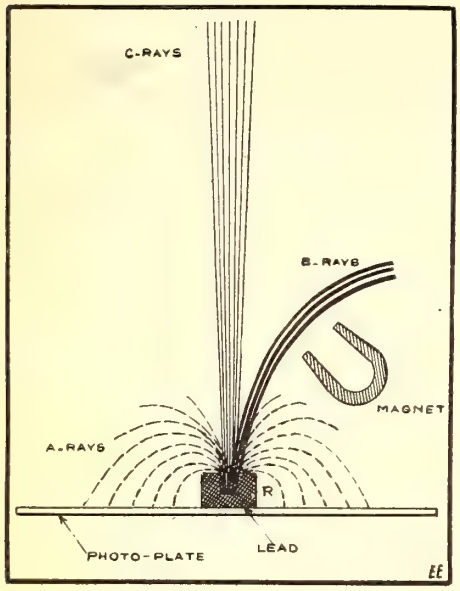


Fig. 1. Showing Effect of Magnet on the "Alpha" and "Beta" Rays.

After Prof. Becquerel had published his reports on Uranium, M. and Mme. Curie, of France, began their wonderful researches independently from Becquerel, and in the course of their tremendous labors discovered Radium and then Polonium.

So far, the element Radium, which we believe to be a metal, has not been isolated in its metallic form. At present we only know Radium Chloride and Radium bromide. We have already, however, ascertained the atomic weight of Radium, which we know to be 236, while Uranium has an atomic weight of 238, while the metal closest related to Radium, namely, lead, has an atomic weight of 206.

Wonderful Properties of Radium.

Let us first enumerate the properties of Radium and wherein it differs from other substances.

If we take a piece of lead, the only remarkable physical properties which we can discover about it is that it is very heavy and that it melts rather easily. If we view it in the dark, nothing can be seen. If we place it on a photographic plate, nothing happens. If we bring it near an electroscope—an instrument which records electrical charges in its neighborhood—the result will be negative.

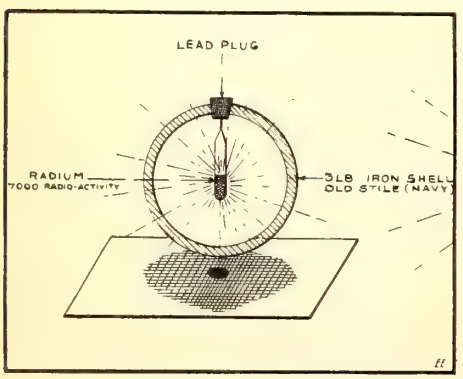


Fig. 4. Lead is Opaque to Radium Rays. The Lead Plug in an Iron Cannon Ball Shows a Black Spot on Photograph as Perceived.

Not so with Radium. If we take a small quantity of Radium salt and place it in a dark room, we will see that it emits a faint glow of light. Place a speck of Radium in front of a fluoroscope, such as is used in X-Ray work, and the screen of the fluoroscope will light up brilliantly, showing the rays to be of a similar nature to that of X-rays.

Indeed, we can prove this by putting our hand on the back of a fluoroscope, placing the Radium behind the hand; if we have a sufficient quantity of Radium, the bones of the hand will be seen clearly outlined on the fluoroscope screen, the same as if X-rays were used.

If we place a speck of Radium on a photographic plate, although the latter is wrapped up in several layers of paper and is placed in a wooden box, the rays of Radium will pass through the box and the paper, blackening the photographic plate.

If we bring Radium near an electroscope, an electrical charge is indicated by the latter immediately, showing that Radium gives off an electrical force.

Radium also gives off what is technically termed as "emanations." Inasmuch as this is a misunderstood term by the average layman, a homely analogy will not be amiss again.

The word "emanation" really means giving off particles of force and matter. The analogy in this case being a garden hose, to the end of which is attached a spraying nozzle. As is well known, the water comes out of this nozzle in very finely divided streams. We can compare Radium to this spray, the emanation being the water as it leaves the spray. But here the analogy ends, as will be seen later.

Radium gives off a number of rays which are invisible to the unaided eye, these rays being termed "emanation," as explained before.

There are three different and distinct types of rays which are known to scientists, respectively, as:

1° Alpha Rays.
2° Beta Rays.
3° Gamma Rays.

The Alpha rays possess certain characteristics of the well-known X-ray, and many have thought these rays to be identical with X-rays, but they do not have any appreciable penetrative power. In fact, they are stopped by a thin layer of air and a piece of paper. They carry with them a positive charge of electricity.

The Beta rays have a much greater penetrative power than the Alpha rays, and the velocity of these rays approaches that of light iself, which is 185,000 miles per second. These rays may be deflected from their original direction by means of a magnet, proving their electrical character. Fig. 1 illustrates this very readily. If we take a piece of lead and bore a small cavity in same, as shown in illustration, and then place a speck or Radium in its cavity, we find that the Alpha rays only make an impression on the photographic plate, as shown. The Beta rays also give off an electrical charge, but unlike the Alpha rays, it is negative, while the former is positive.

The third rays, that is the Gamma rays, possess the greatest penetrative effect of the three. These most powerful rays produce radio-activity through the air for a considerable distance, but they appear not to carry any electrical charge with them, for the reason that they are not influenced by a powerful magnet. That the Alpha and Beta rays carry an electrical charge, or, in other words, give off electricity continuously, is best proven by the following experiment. Refer to Fig. 2.

If we take a gold leaf or aluminum leaf electroscope, as shown at A, and charge it by means of an electrified rod of hard rubber, the two leaves will diverge, as seen. But as soon as any substance containing Radium or pure Radium salts is brought near the electroscope, as shown at B, the leaves will collapse. This action is due to the fact that the rays charge the leaves with opposite electricity, thereby causing them to collapse, again proving Radium to be a body that gives off an electrical charge.

The wonder about Radium, however, is not that it emits these rays and electrical charges, but the mystery so far unsolved is *that it does so continuously and almost indefinitely,* contrary to any other known element so far discovered. In our analogy before we spoke of an automobile tire, if punctured, that never became empty. Exactly so with Radium. It gives off energy without any apparent loss of weight or power or intensity, and while this process seems to go on indefinitely, this really is not the case.

The most remarkable property of Radium, however, is found in its ability to give out a considerable amount of heat without cessation; thus, if a thermometer is placed in a tube containing Radium or Radium salts, and if the thermometer is sealed air-tight to the tube, it will be found that this thermometer always registers a 2.7 degree Fahrenheit higher temperature than the surrounding air.

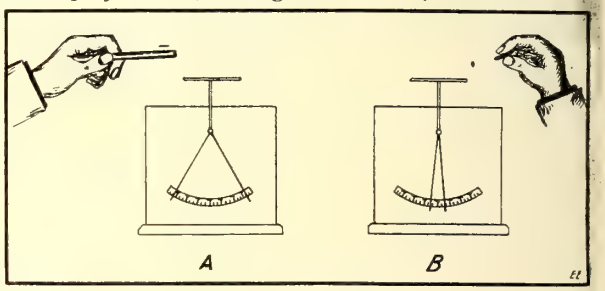


Fig. 2. Demonstrating How if Radium Is Brought Near a Charged Electroscope (A) That It Will Be Discharged (B) Owing to Electronic Rays Shot Off by the Radium.

How immense the energy produced by Radium is may be better understood from the following: *One ounce of Radium will raise one ounce of water from freezing point to boiling point in one hour. And heat continues to be produced at this rate, not for one hour, not for one day, not for one year, but for* 2,500 *years,* before the Radium finally gives out! The greater part of this ponderous energy is produced by the energy of the Alpha particles of the Radium emanation.

A thimbleful of this emanation would contain about seven million calories of heat, sufficient to raise 15,000 pounds of water 1 degree! Weight for weight, the heat evolved by the Radium emanation is nearly one million times greater than that let loose by any known chemical reaction.

Life of Radium.

Prof. Rutherford, who probably to-day is the greatest authority on Radium, has calculated the average life of Radium to be within the limit of twenty-five hundred years. In other words, a given quantity of Radium will furnish energy for twenty-five hundred years without stopping. It is this property which makes Radium so wonderful and so unlike any other substance and element we know. Before Radium was as well understood as it is to-day, it was even thought that we had here an approach to perpetual motion, but we have since learned

that this is not the case. But it is truly remarkable that any substance should be able to give forth such a tremendous power for



Fig. 5. Radium Picture of Mouse. Exposure 24 Hours. Photo Taken by William J. Hammer.

such an exceedingly long time without materially weakening.

However, there is probably something behind this which we have not as yet ascertained. A theory of the writer has long been that Radium is nothing but a form of "sponge" which takes up within itself some unknown to us energy, transforming it into an electrical energy. While this theory has not been proved nor disproved, it opens up a new avenue in research. Undoubtedly, something of this sort must take place, as otherwise Radium would be contrary to almost every rule of the conservation of energy.

Scientists from time immemorable have been trying unsuccessfully to transmute a lower grade metal into one of the higher orders. Thus many of the alchemists have tried to convert lead and other heavy metals into gold, silver and other precious metals, without success. Radium, at last, has given us a means by which this may some day become accomplished. Our Fig. 3 shows graphically how the alchemist's dream has at last come true. Here we see how one element is actually changed into another one. In other words, it shows the transmutation from Uranium to Radium, from Radium to Polonium, and from Polonium finally to Lead. While this has not been conclusively proven so far, the indications are that the sequence as stated above is the correct one, and from this it may be inferred that at some not far distant date it will be possible to change one metal into any other given one.

It is thought by many scientists that Uranium is broken up and disintegrated into Radium, as shown in our Fig. 3, which shows the subjects at which the Alpha rays, Beta rays and Gamma rays are respectively emitted during the break-up, if such really occurs with the so-called Radium atom. While various theories have been brought before the scientific world, none of them has as yet been accepted as final, on account of the different results each observer obtains, and for this reason no final conclusion can be stated here.

As we also stated above, the disintegration of Radium is continuous, and while the average life of Radium has been calculated to be twenty-five hundred years, this, however, is not final and is merely hypothetical.

Various Radium Effects.

Prof. Rutherford, who has conducted a most painstaking investigation into the penetrative character of all the radiations of Radium, Uranium and Thorium, has found that lead was the best insulator for the radio-active rays, and for this reason Radium is always kept in lead cases or lead bottles. Fig. 4 shows this very nicely. Some Radium salt is placed in a glass tube, the latter being attached to a lead plug, and the tube is then inserted in a three-pound iron shell, such as have been used in the past by the navy. If this apparatus is now placed upon a photographic plate, the rays will of course pass through the iron shell, but cannot pass through the lead; the rays will now be reflected from the lead plug and will strike down in the axial direction of the tube. When the photographic plate has been developed, it is found that a picture of the lead plug has been photographed on the plate, simply by reflection. In this case the rays not only penetrated the iron shell, but also the rubber cover which enclosed the photographic plate on which the shell rested. A strong black spot in the center of the picture was the result.

An interesting photograph is shown at Fig. 5, which is a Radium (X-ray) picture of a mouse. This mouse was radiographed in about 24 hours by placing it directly on a photographic plate, six inches above which were supported on a cardboard frame six

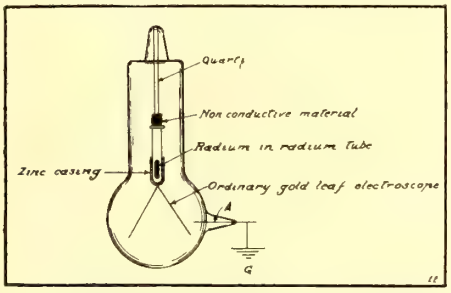


Fig. 7. Radium Will Run This Clock 2,500 Years. The Nearest Approach to Perpetual Motion.

tubes of Radium having the following radio-activities: 40, 100, 250, 1,000, 3,000 and 7,000, as compared with Uranium (the standard). This arrangement was put in the bottom of a trunk, the trays being replaced, and the trunk wrapped in three thick rugs and kept in a dark room. This picture well shows the powerful penetrative power of these wonderful rays.



Fig. 8. Radium Light is Practical, and Actually Permits One to Read 6 Feet Distant From the Bulb.

Besides having all the wonderful properties enumerated above, Radium still has another property, and that is its effect upon man's body. One of the earlier Radium

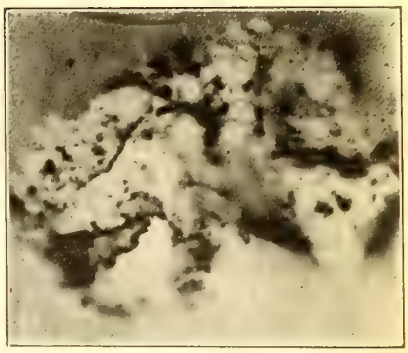


Fig. 6. Auto-Photograph of Piece of Pitchblende Taken by Its Own Rays.

scientists was carrying a glass tube containing Radium salts in his vest pocket. While there were no bad effects to be perceived, and while the Radium did not seem to do any harm when placed upon the naked skin for a short time, bad burns appeared within a few days, which proved to be exceedingly hard to heal, and produced worse effects than the well-known X-ray burns which many persons experimenting with the latter rays experience.

In connection with this, however, a very curious paradox has been discovered by Dr. Robert Abbe. In a lecture on "X-ray Epithelioma Curable by Radium," Dr. Abbe recently delivered a paper to the *Journal of the American Medical Association*. This scientist claims that by using Radium in a certain manner, these X-ray burns can actually be healed by means of Radium. This seems more proof that the properties of the Radium rays are vastly different to those of X-rays.

As said above, Radium is not without its dangers. It is also very dangerous to the eyes, and if Radium is viewed very closely it may result in ultimate blindness, if the experiment is carried on for any great length of time. In connection with this, a curious fact was found in the following:

If a person is taken into an absolutely dark room, and if a small tube containing a Radium salt is placed directly over the closed eye, a strong sensation of light within the ball of the eye is experienced. Some explanations have been offered as to this result, but none is quite satisfactory.

While Radium is no doubt dangerous, if handled by the layman, the medical profession has already made great use of the mysterious element. It seems that cancer and some other diseases have been actually healed by placing a minute quantity of Radium, sealed in a tube, on top of the sore. Some phvsicians have even gone as far as to open cancers and placing a very small tube in the inside of the diseased flesh, and in many cases a permanent cure has been the result. In case of cancer of the stomach the patient has been made to swallow a small glass vial containing a very minute quantity of Radium salt, thereby bringing the latter in close contact to the cancer, and in this case also many cures have resulted.

Of course such experiments must be carried out very carefully, and it is especially the quantity of the Radium salt that is important, for if too much is used disastrous results will be experienced.

Of course, we are but at the beginning, and more wonders and cures are to be expected by the direct application of Radium.

A curious experiment was performed by Mr. William J. Hammer, the well-known experimenter, who several years ago visited the aquarium of Naples, Italy. This aquarium has a large collection of electric fishes, and Mr. Hammer experimented with the *Torpedo Galvani* and the *Gymnotus Electricus*. As is well known, these fishes are capable of dealing a very powerful electric shock, if the bare hand is brought in contact with the body of the fish. The shock, in some cases, has been strong enough to kill a grown man. Mr. Hammer, who had obtained several tubes of Radium from the Curies, of Paris, placed these tubes directly upon the body of the fish. The tubes were left for some 20 minutes in contact with the fish's body, and it was found that the Radium emanations had entirely dissipated the fish's electrical charge and the animal was no longer capable of giving electrical shocks for quite a time.

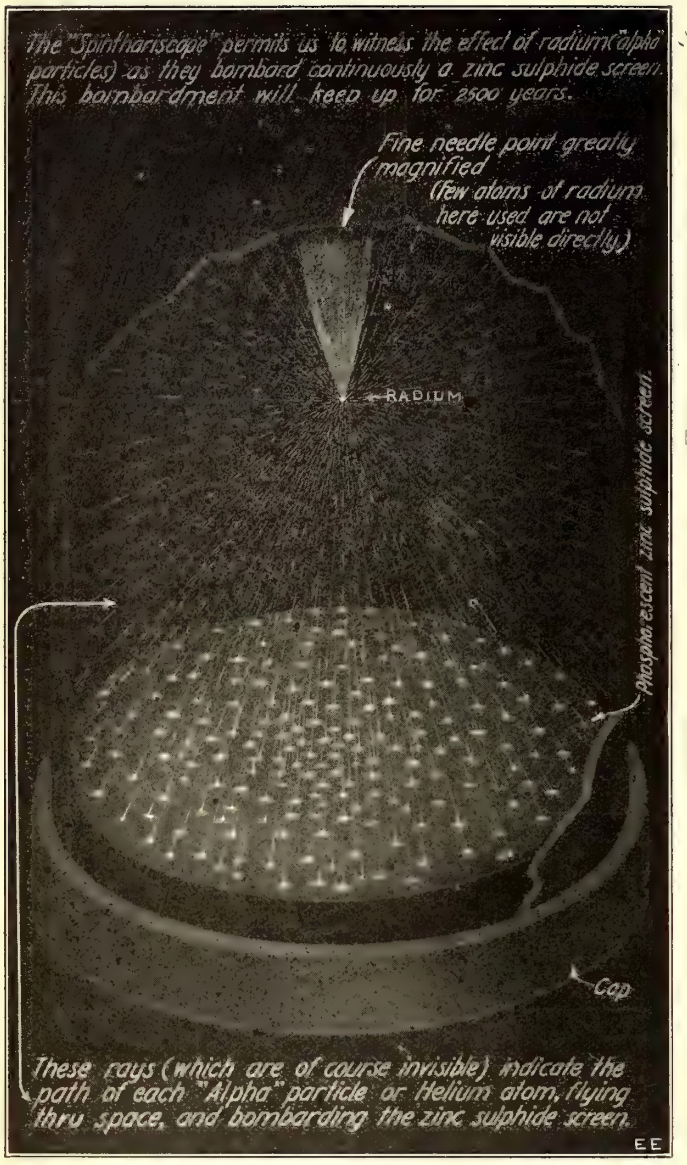


Fig. 11. Magnified Sectional View of Interior of Spinthariscope.

Radium Supply of the World.

There is but very little Radium in the hands of man to-day. By this we mean that only about one pound of Radium or Radium salts is actually in use, for the reason that Radium is one of the most difficult substances that can be obtained. At the present time almost our entire supply is obtained from Austria, from the mineral called "Pitchblende," and this form of pitch is highly charged with various Radium salts. There is only one part of the element Radium for every 3,200,000 parts of the element Uranium in Pitchblende. Of course, the Pitchblende may be of any degree of richness from only a few per cent. to over 50 per cent. of Uranium, but between 100 and 200 tons of even the richest Pitchblende would be required to produce an ounce of pure Radium. The commercial compound, usually called Radium bromide, if pure, contains some 58 per cent. of Radium. It is like the myriad of roses we are told go to make a single drop of attar, which is almost priceless.

The Radium that is extracted is a million times more radio-active than the mineral, and several million times more than Uranium itself. Our Fig. 6 shows the autophotograph of a small piece of Pitchblende, which was placed on a photographic plate in the dark, making its own photograph by means of its own rays. We might also state that Radium itself is not luminous, and this is best proven by the fact that weak Radium preparations shine by themselves more in the dark than the pure Radium salts, owing to a phosphorescent action of the impurities which are to be found in the weaker salts.



Fig. 10. View Through Eye-Piece of Actual Spinthariscope.

Practical Applications of Radium.

We now come to the practical applications of Radium. We have shown in our Fig. 2 how the leaves of an electroscope can be made to converge and diverge, and it is upon this principle that Prof. Strutts has designed what he calls a perpetual clock. This is the nearest approach to a practical perpetual device as yet invented. Our Fig. 7 gives a view of this. It consists of a glass bulb, as depicted, which encloses a gold leaf electroscope, some Radium salts and a wire, which latter is connected to the earth. These parts are arranged as shown, and it works as follows:

The emanation of Radium charges the leaves, which diverge slightly until one of them touches the wire at A. As this terminal is connected to the ground, it carries off the electrical charge from the leaves, leaving them uncharged, and they consequently will collapse. The Radium, however, which gives off a continuous charge of electrons, charges the leaves anew, which open, then discharge, and then charge again. A suitable delicate contact could no doubt be arranged to the leaves, so that it would close a secondary electric circuit operating an electro-magnetic device, which would then operate an electric clock. Or a very sensitive attachment could be placed directly inside of the bulb, which would operate some very light hands playing over a clock dial. With suitable means an accurate Radium clock could thus be constructed, no doubt.

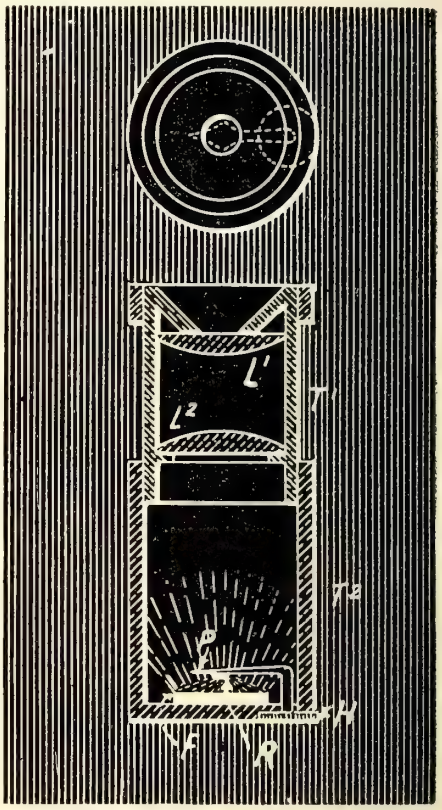


Fig. 9. Details of Spinthariscope Whereby Effects of Radium May be Observed.

We have shown before that Radium is capable of lighting up a fluoroscope screen, and an interesting application is found in producing light through means of this property. In the future it is well possible that buildings and streets may be lighted by means of a similar arrangement as that explained hereafter.

Professor Curie constructed an apparatus as illustrated in Fig. 8. It consists of two large glass bulbs, one having a solution of Radium salts, the other a small quantity of phosphorescent zinc sulphide. The two

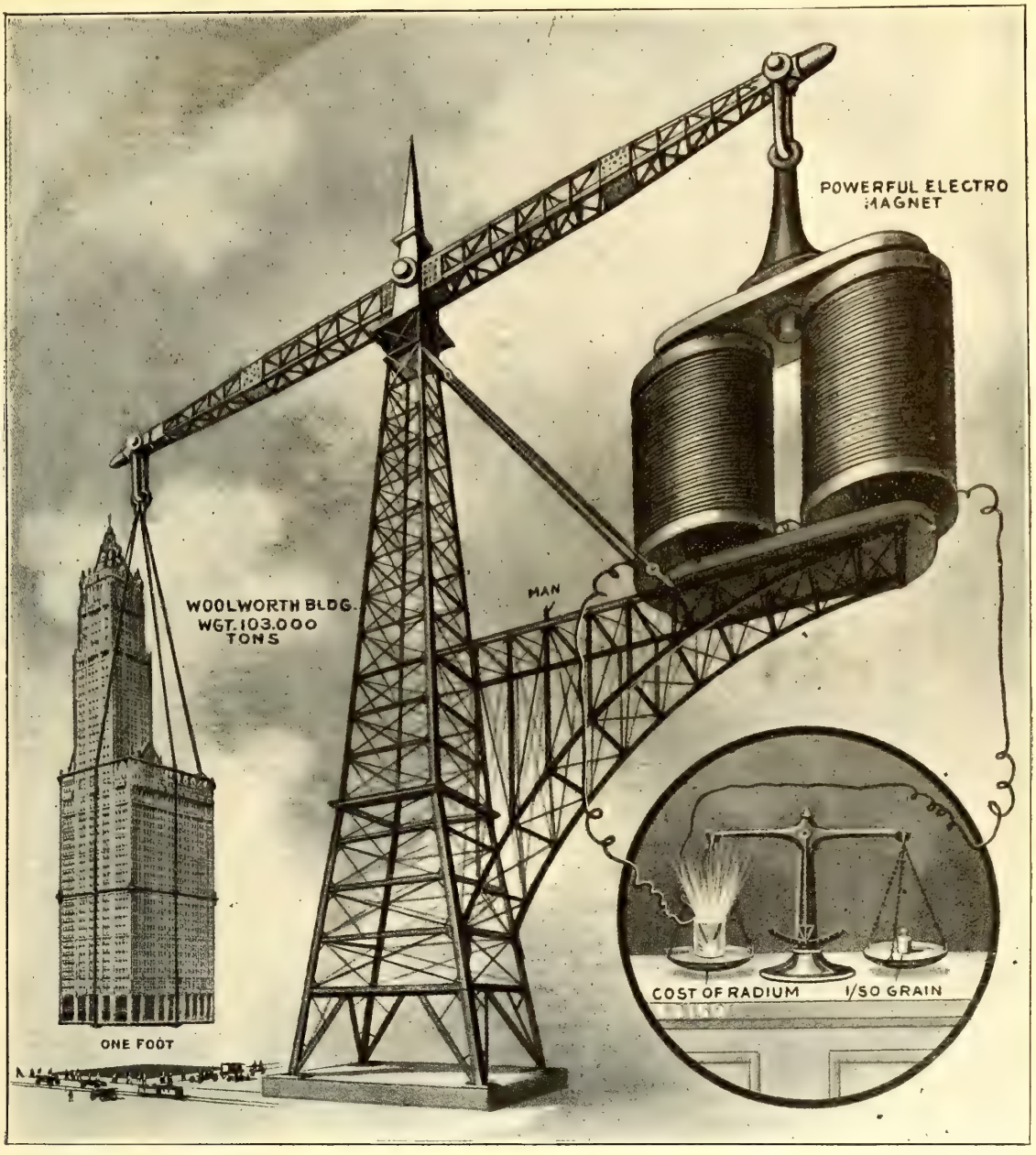


Fig. 14. How (Theoretically Considered) the Energy Contained in 1/50 gram of "Radium" Could Lift the Massive Woolworth Building 1 Foot Above the Ground.

bulbs are connected by means of a glass tube, in the center of which is a stopcock. Upon placing the apparatus in a dark room and opening the stopcock, the Radium emanation will be sent from one bulb through the tube over to the zinc sulphide, and this salt will be immediately illuminated with such an intensity that one is able to read a newspaper six feet away from the bulb, as shown in our illustration. This is so far the nearest approach to cold light as yet invented. As nothing is consumed, such a lamp would, of course, last almost indefinitely.

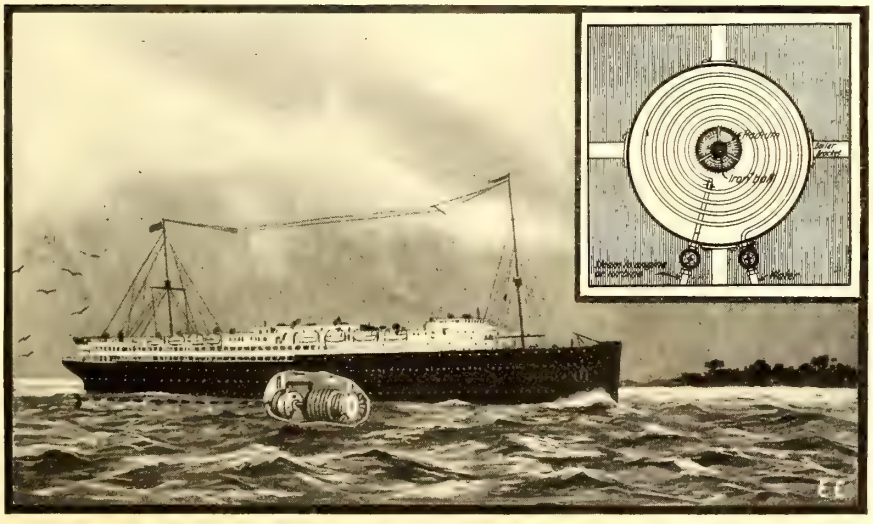


Fig. 12. Modern Ocean Greyhound Being Driven with Radium. Insert, Fig. 13, is Detail of Radium Boiler.

A very clever instrument working on the above principle and termed "Spinthariscope," invented by Sir William Crookes, is illustrated in our Fig. 9. It consists of the following:

There are two brass tubes, T^1 and T^2, the upper sliding into the lower. The upper tube carries two condensing lenses, L^1 and L^2. At the bottom of the lower tube we see a small screen F, covered with phosphorescent zinc sulphide. In front of this is a small pointer P, bearing a small quantity of a Radium salt R. This pointer may be revolved from the outside at H.

(*Cont'd on page* 236.)

Combating the Submarine by Electrical Means

By H. Winfield Secor

THE submarine has already shown its wonderful flexibility in manoeuvering under war conditions and it has kept inventors busy right along, who have endeavored to perfect some means, electrical or otherwise, to detect the presence of such a submerged war vessel even though it be several miles away from its intended prey. A number of different schemes have been proposed and tried out in some instances, but without much success. In the present article some of these schemes will be considered briefly, and they include wireless and other diversified plans and arrangements.

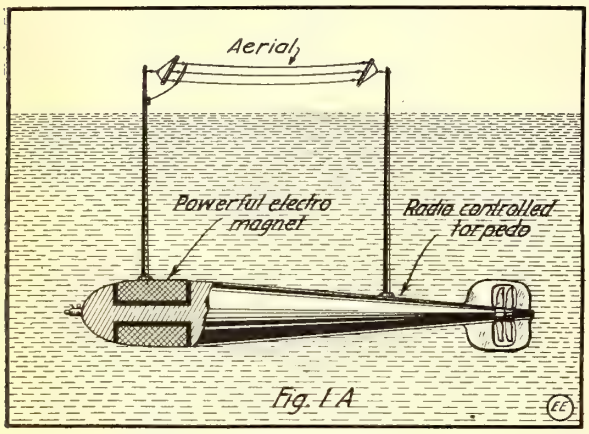


Fig. 1A. Wireless Directed Torpedo Carrying Powerful Magnetic "Head."

One of the latest wireless torpedo schemes has been evolved by a Mr. Gardiner, of Fleetwood, England, and our front cover depicts his scheme in a graphic manner. Simply explained, his arrangement is as follows

An aeroplane, it has been found, can see a submarine when submerged even 150 feet below the surface of the water. It carries a powerful wireless set, and its means of destruction, as regards a submarine cruising under water constitutes a powerful torpedo which propels itself under water and is subject to the wireless control of the man in the aeroplane. The wirelessly controlled torpedo in this case is suspended by proper wires or cables from a non-sinkable float, the latter carrying suitable antennae to pick up the wireless control waves as sent out from the aeroplane flying overhead.

This idea of Mr. Gardiner's has been very favorably received in England, and it is said that it will shortly be tried out by the English Admiralty. This scheme seems to hold good promise, as is evident in view of the known facts in the case, viz., that it is possible for an aeroplane scout to see a submerged submarine boat many feet under the water, and also that there are successful wirelessly controlled torpedoes existing at this time. Therefore, this invention seems indeed practical, and when the aeroplane scout spots a submarine coming along under the water, he sends out a proper wireless control wave, which causes the non-sinkable float and its attached torpedo to proceed directly toward the submarine. Also it is possible to control by wireless waves suitable mechanisms, such as take-up drums, on the torpedo, so as to cause same to rise or descend. Ballast tanks might be thus controlled for the purpose. The explosion of the torpedo could be, firstly, by concussive contact in the usual manner, or, secondly, it could be exploded by wireless means from the aeroplane; and it would not matter whether the torpedo exploded a couple of feet from the submarine or at a considerable distance from it, as the force of the explosion is transmitted through the water to a considerable distance, owing to the (practically) incompressibility of this liquid

We have all heard, probably more or less, about these torpedoes which can thus be controlled by radio waves of different frequency. In this connection a new suggestion is made as outlined at Figs. 1A and 1B, in the form of a radio controlled torpedo, carrying an aerial as observed, and also having its "head" fitted with a powerful electro-magnet. A scheme is suggested by the writer which, though theoretical in a way, might be applied under certain conditions for the protection of a warship, and also for the purpose of searching out a harbor, etc. This scheme would operate on the principle that, to begin with, we have a powerful wireless controlling station, either on board a dreadnaught, or on the harbor shore. Wirelessly controlled torpedoes of the type shown at Fig. 1A are then employed with the strong electro-magnets attached to them as aforementioned.

Referring to Fig 1B, it is seen how four zones (and of course more zones could be provided for) are covered at different times by wirelessly controlled torpedoes, sent out from properly devised and arranged torpedo discharging tubes. It is to be noted that when the radio torpedo A is at the point shown that its mate, say at B, is opposite it, but traveling in a different direction, and that when B has reached the point X the torpedo A will have reached the point X^1. This holds good also for torpedoes C and D. Thus, by sending out these radio controlled torpedoes, which can be directed and made to go in any direction desired, they are caused to search out the water for several miles in the vicinity of the ship. It is proposed that a ship would carry a net, so as to be able to pick up its returning radio torpedo without danger to itself. Tests made about two years ago in the English navy with torpedo nets proved that torpedoes could be picked up very easily by allowing them to strike the net and then picking them up by means of grappling irons.

An electrical scheme (it is said) is being used in several navies for the detection of submarines or other vessels when several miles away, which involves the use of an extremely sensitive microphone submerged under water and pivotally mounted on the side of the war vessel or dreadnaught. This device is illustrated at Fig. 2. By suitably arranging the microphone M so as to be constantly and rapidly rotated about its axis, it is seen to cover a complete circle about the ship, as indicated by the dotted line A and B. By properly constructing the microphone M and a horn on same, it seems possible that this method would allow of detecting the sound of the machinery, and especially the *propeller*, of the enemy's war vessel to within a single degree of the compass. Not only does this method seem undoubtedly feasible, but also, with the several types of amplifiers now available, it is a simple matter to hook up one of these with the circuits of the microphones M and to thereby increase the activity and usefulness of this arrangement. As submarine wireless telegraphic communication is carried on by sound vibrations transmitted through the water up to a number of miles, there is no reason why this scheme should not prove efficacious in every way. Of course, suitable telephone receivers or other indicating means are connected to the microphone circuits.

In this direction of scientific apparatus for the detection of the presence of a hostile warship in the neighborhood of a dreadnaught there is often brought up a more or less logical argument by many, viz., that, having obtained the information aforementioned as to the presence of a submarine, say, then what good is this information after it has been obtained? The answer to this argument would be, it seems, that if those on board the dreadnaught are duly apprised of the fact that a submarine lies within active range of them, then they will take all necessary precautions to ward off any attack by such a vessel. It is evident, of course, that this microphone scheme, for instance, of detecting the presence of a hostile vessel would do its duty, even though the submarine is cruising under water with its periscope out of sight; and if this or a similarly efficient arrangement is not utilized, then it is certainly impossible for those on the dreadnaught, under ordinary conditions, to know of the presence of such a boat.

The dream of a great many inventors in the wireless line, including Ulivi, of Italy, has been to utilize some special form of wireless ray or wave which could be directed toward a submarine or war vessel of any type, and that would cause the powder magazines of same to explode, thereby destroying the hostile vessel.

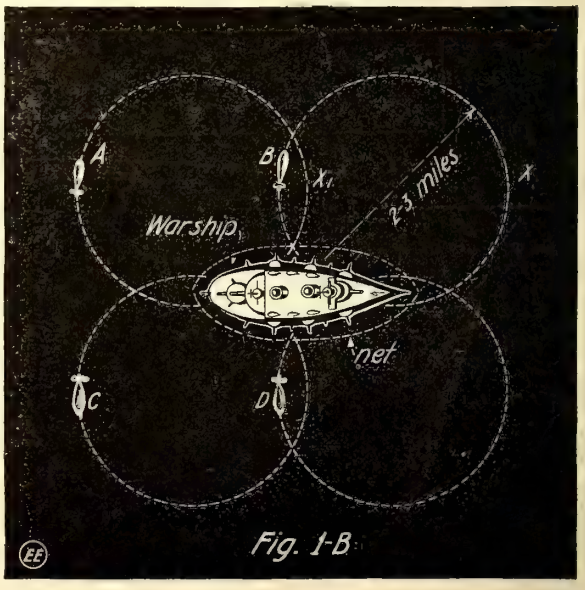


Fig. 1B. Scheme for Protecting "Dreadnaught" from Submarine with Several Radio Directive (Scouting) Torpedoes.

Ulivi's scheme was demonstrated, it is

claimed, before bona fide naval authorities of several foreign governments, but it has since been stated in several instances that the tests were a hoax and, moreover, that he could not produce the effect he claimed to have achieved with the apparatus employed. Several of the best radio authorities and scientists in this country and abroad have since gone on record as stating that it is indeed very doubtful if there ever

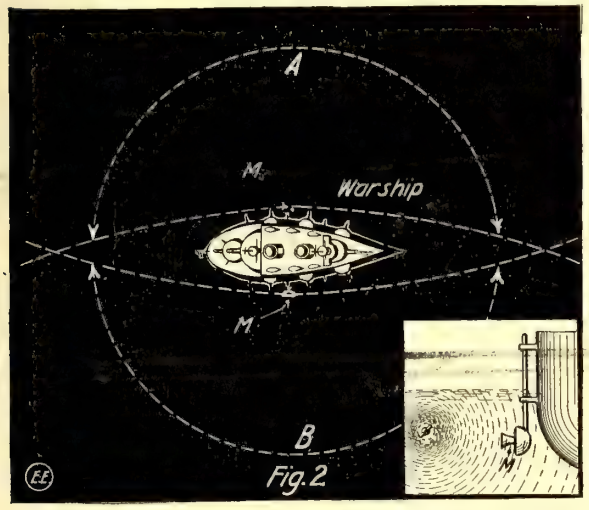


Fig. 2. Super-Sensitive Microphone Picks Up Sound of Submarine's Propeller and Machinery. Note Sound Waves (in Insert) Striking Microphone.

will be such a "wireless ray" perfected which would explode a submarine or the powder magazine in a dreadnaught. This seems, in the writer's opinion, to be the conclusion, reached in any event along this line of research, as in all cases the explosive is encased in metallic shells which are highly impervious to radio waves. Even if such waves do induce (as we know they can) minutely small local currents inside of the metallic shell encasing such explosives, they, as tests have often demonstrated, circulate around the shell and in some rare cases do produce a small spark between two sections of such encased metallic shells where they are not joined together firmly and metallically.

However, and even though this effect is possible, it should be remembered that at a distance of a few miles, even, the energy so produced and localized in a metallic body or shell by wireless waves radiated from a central station is very small. Undoubtedly, from what has been published of Ulivi's work, this effect is what he intended to utilize in his marvelous ray that would blow up all the battleships in the world. If Ulivi had succeeded in his arrangements and apparatus they would undoubtedly have been employed long ago. So there are still good opportunities for some bright genius to bring forth a successful combatant for the modern terror of the seas, "the invisible submarine."

ON CURING ILLS BY ELECTRICITY.

A distinguished European physician, Kowarschik, declares that we are entering on a new era in the field of electrotherapy, as the mechanical technic has been so perfected, while our knowledge of the biologic and therapeutic action of electricity has been deepened in recent years.

The theory of electrons and ions has provided a scientific basis for therapeutic action, a basis more solidly planted, he insists, than we have for the action of most of our drugs. Among the favorable accounts of ion treatment published recently is that of Aufaure with acute and sub-acute articular rheumatism treated by driving a 10 per cent. solution of sodium salicylate directly into the joints with the electric current. The effect was found to be superior to that with internal administration of the drug.

Excellent results in the treatment of chronic nose and ear disease and sinusitis are reported by Friel. A 1 per cent. solution of zinc sulphate, with a current of two or three milliamperes, was used at a 10-minute sitting and repeated at eight of 10-day intervals. Sometimes a single sitting completed the cure.

About half of the cases of sinusitis thus treated were cured and a large proportion of the middle-ear cases. Kowarschik says the eye and ear affections seem to offer a specially favorable field for diathermy, as also malignant growths of all kinds.

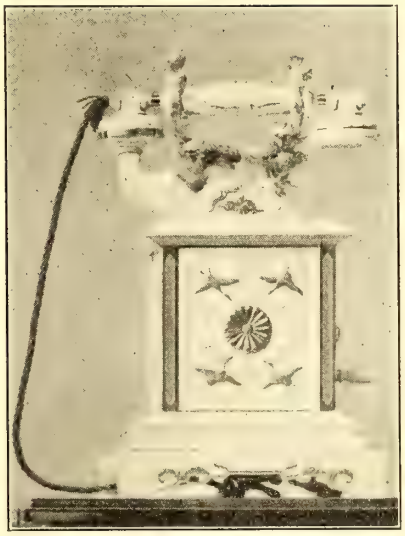
RADIO TIME SIGNALS SENT 4,250 MILES.

The wireless signals sent out by the United States Naval Observatory at Washington have been caught as far away as a point 600 miles north of Rio de Janeiro, which is 4,250 miles from the Government station. Watchmakers, jewelers and colleges throughout the country have installed apparatus for catching the signals. In the past year the daily error in transmission ranged from .055 second to .36 second, due to a change of rate in the standard sidereal clock in consequence of overhauling.

The observatory is seeking an appropriation from Congress for more efficient sending apparatus, declaring that the increased use of the signal for astronomical and other purposes requires a higher degree of precision.

ELABORATE JAPANESE TELEPHONE SET.

The illustration here portrays a very beautiful and odd telephone desk set, decorated with ivory, gold and silver, and which cost about $3,500 to build. This set is illustrated by courtesy of the *Western Electric Co.*



Beautiful Telephone Set Presented to Emperor and Empress of Japan.

This very elaborate telephone instrument was presented to the Emperor and Empress of Japan at the time of their marriage. Some of the Japanese telephones are works of art, but in America we are content to have one standard of finish for our telephones, which makes for maximum efficiency as to talking qualities as well as wearing qualities.

RUBBER PRODUCED ARTIFICIALLY BY ELECTRICITY.

By Frank C. Perkins.

Our illustration shows the electrical equipment by means of which a Cleveland doctor believes rubber can be produced artificially, the chief ingredient of the product being coal tar.



Electrical Apparatus with Which It Is Claimed Substitute for Rubber Has Been Made.

Dr. Lyman A. Noble, an electro-therapist, has declared he has discovered a formula by which a substitute combining all the qualities of natural rubber can be produced. For nearly a year Dr. Noble has been experimenting with ingredients and processes for the production of artificial rubber.

In the process he uses a high frequency electric current. In his first experiments he sought to produce rubber by evaporating the liquid combination of ingredients. This did not produce the desired result, and in addition to the evaporation process he conceived the idea of submitting the liquid to the high frequency current for an extended time—six hours—and the result was obtained.

It is stated that from 200,000 to 500,000 volts of electricity of high frequency is necessary to produce the rubber. With a current of 1,000,000 volts the time would be greatly cut down, he states.

The various ingredients are mixed, by secret formula, into a liquid which, under heat, is evaporated down to one-quarter of its original mass. When it has reached a consistency of a thick syrup the mass is placed in a metal retort and connected with a high frequency electrical machine used by Dr. Noble, and the retort forms one pole while the other pole is suspended in the liquid. The current is turned off after six hours; the retort contains a black, spongy substance with all the qualities, it is claimed, of natural rubber. A series of tests show that the product resists both wear and punctures to a greater degree than regular rubber.

NEW LOUD TALKING TELEPHONES USED BY THEATERS.

A NEW form of attraction recently installed by a progressive New York City theater is that involving the use of a loud-talking telephone arrangement. This apparatus is illustrated herewith, and it involves several very unique features.

To begin with, this instrument operates on a 110-volt circuit, and the microphone, of the carbon grain type, as shown at Fig. 1, has a diffusing button placed at the base

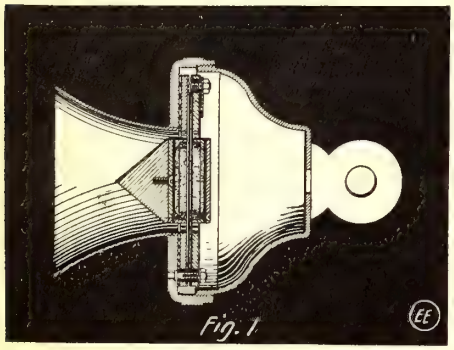


Fig. 1. Special 110 Volt Style Microphone Transmitter for Loud Talking Enunciator.

of the mouthpiece, as perceived. This transmitter is hooked up in series with a couple of 110-volt tungsten lamps of about 50 watts capacity, and it actuates directly the resonator or reproducer, shown at Fig. 2.

The horn on this reproducer is only about

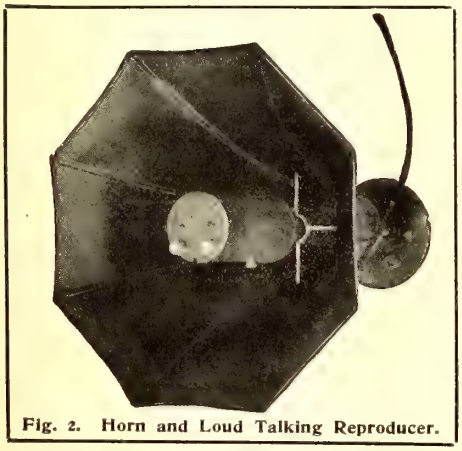


Fig. 2. Horn and Loud Talking Reproducer.

18 inches long, and the appearance of the complete reproducer, with magnet coil, is shown at Fig. 2.

The transmitter is of peculiar construction and especially adapted to stand a heavy current. It employs in its make-up three distinct electrodes, and as it thus has a compartment, containing carbon grains, placed at both sides of the center diaphragm, it is seen that, as compared to the ordinary transmitter, having but one carbon grain chamber, its current carrying capacity is 100 per cent. greater. This microphone has several other distinct constructional features which permit it to be inserted in the 110-volt circuit, and it does not overheat, even when used for half an hour or more at a stretch.

When used to energize from one to five loud talkers or reproducers about ¼ ampere of current is best passed through the microphone.

The special double microphone arrangement, with suitable arm, etc., for use on talking machines where music is to be transmitted through loud talkers, is illustrated at Fig. 3. This specially arranged talking machine is driven by an electric motor, and the switch for operating same may be seen on the side of the cabinet. The two microphones forming the transcribing head in this case are actuated by the regular stylus needle resting on the graphophone record, and suitable wire lead along the microphone arm to and from them.

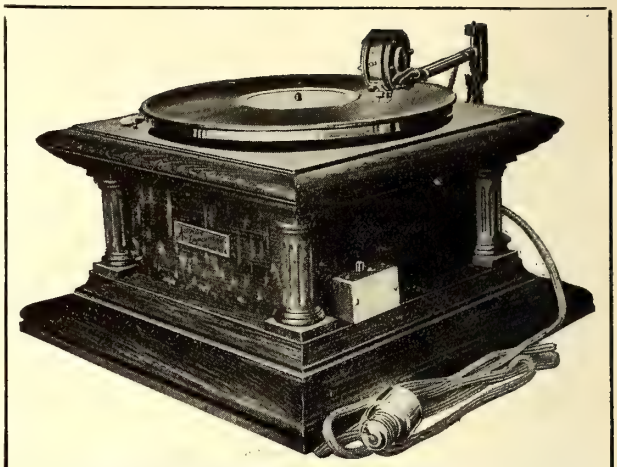


Fig. 3. Special Graphophone and Microphone Arm for Producing Music Through Loud Talkers.

Considerable interest centers in the improved construction of the loud-talking reproducer, shown at Fig. 2. At Fig. 4 the details of the inside mechanism of the reproducer are portrayed. Several years were spent in developing this type of reproducer, which operates on the lever principle. The whole mechanism, shown at Fig. 4, is encased in a tubular metal chamber about 3 inches in diameter by 8 inches long. Large bars of the best grade tungsten steel are used as permanent magnets, and an electro-magnet coil similar to those used in regular telephone receivers or reproducers is mounted on the end of the permanent magnets at A. The iron armature, which is very carefully built, is at one end, directly supported by one pole of the permanent steel magnets, and the other end of the armature is supported and held 2/1000 of an inch from the head of the other pole piece by a mica diaphragm, which is embedded in a rubber cord. A system of levers connects the vibrating end of the armature with the mica diaphragm in such a manner as to cause this diaphragm to have a magnitude of vibration from two to three times as great as the armature. The large volume of sound obtained in this perfected loud-talking reproducer or receiver is due to the powerful magnetic circuit and also to the amplifier vibration effect. The tone quality is due to the mica diaphragm, which has been found much superior to the usual metal form, and also to the manner in which it is mounted in the sound box.

This arrangement is being used for railway station train announcement, restaurant purposes, et cetera, and apparently works better than anything placed on the market heretofore.

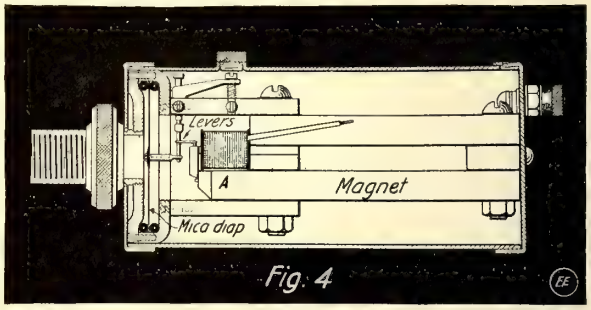


Fig. 4. Reproducer Construction Details.

The reproduced speech from the loud talkers can be heard over distances of 500 to 600 feet, and the articulation is very distinct and perfect; if anything, more so than when holding conversation over the ordinary telephone.

WATERPROOF CEMENT OR CELLULOID.

Celluloid is becoming increasingly popular as a material for making a great many articles. Broken parts are sometimes cemented with a form of glue, made by melting gelatine in sufficient glacial acetic acid to cover it by means of gentle heat, after first standing for 24 hours in the cold. This cement, while strong, is not waterproof. A better cement, and one that will withstand the action of water, can be made by dissolving small cuttings of celluloid in acetone to the consistency of a thick syrup. After applying this solution to the parts that are to be united the work must be placed under pressure and left for some time until the cement is quite hard.

PRODUCTION OF MICA IN 1914.

The value of the mica produced in the United States in 1914 was $328,746, a decrease of $107,314 from 1913, according to a statement of Douglas B. Sterrett, of the United States Geological Survey. The production came from 13 States. The output of sheet mica amounted to 556,933 pounds, valued at $277,330, as compared with 1,700,677 pounds, valued at $353,517, in 1913, and the production of scrap mica in 1914 amounted to 3,730 short tons, valued at $51,416 as compared with 5,322 short tons, valued at $82,543, in 1913.

There was also a decline in imports of unmanufactured and trimmed mica.

A METER, SOME SPIDERS AND A MOTH BALL.

Electric meters in the earlier days of the industry were not always made dust-proof. In fact, it was often possible for wily patrons of some electric light companies to introduce spiders into their meters through cracks in the cases. One spider if introduced promptly after the meter was read would spin enough web, it was learned, to retard the meter disc and to effect a considerable reduction in the electric light bill. According to stories told by operators of those early days, a single moth ball if placed in each meter case could be depended upon to eliminate all trouble from spiders.

Some Late Theories for the Young Scientist

By Rogers D. Rusk, Science Dept., Defiance, O., High School

HERE in the United States we have a vast army of boy scientists and experimenters from whose ranks the masters of theory and the practical inventors of to-morrow will arise. A deal more would be accomplished and a greater number of these budding geniuses would be more surely successful, if they had proper guidance in their early efforts. The writer wishes in the present article to point out a few of the more important theories of the day and the opportunity for their further development.

Men, from time immemorial, have pondered on the great questions of this life, and the ancients who spent their lives in search of rich truths were known as philosophers. Very soon philosophy was divided into two great divisions: one being the study of life, its reason and purpose, and the other being a study of matter and force and all the phenomena of nature. From this the latter was called natural philosophy, or, as we now know it, the science of physics.

Many have been the theories regarding the construction of matter from the subjective theory that matter exists only in the mind, to our latest, the electronic theory. The atomic theory of matter, of which the electronic theory is only a deeper interpretation, has become so well founded and satisfying that scientists now never doubt its general validity, but the farther and farther we study, the more we see that all theories are more or less *glittering generalities,* whose greatest use is to give us room to stand on while we endeavor to grope and feel a little farther.

Matter was first found to be divisible into small particles known as *molecules.* These were the smallest particles of a substance which would still retain their original characteristics, and these molecules it was later found could still be divided into the different elements or particles of which they were composed, and these smallest divisions were called *atoms.* It remained now only to find what the atom was made of to know the actual constitution of matter.

In the last few years experiments have proved that the atom is a kind of miniature universe all in itself, and that there seems to be a central body or nucleus and other particles or *electrons* as they are called, revolving about the nucleus, at a probably very great relative distance from it. Certainly our universe seems as infinitely extensive toward the minute as it is limitless in the opposite direction, and few of us realize how probable it is that each universe is only an infinity of smaller ones.

The electron theory is a big step in scientific advance, for now we see that it is possible for all the different kinds of matter to have the same fundamental constitution of nuclei and electrons except in a different number and arrangement. Just what may cause any particular arrangement, whether from internal or external forces, is a big question, and one which will probably puzzle scientists for a long time to come.

The fundamental unity of matter has been the pet theory of many scientists, but a difficult one indeed to prove. A fact often employed to substantiate this theory is found in astronomy. By means of the "spectroscope," the different elements of the stars and planets may be analyzed and in the very young nebulae, which are solar systems in the making, only a few elements are found; while in nebulae in more advanced stages of development, more and more elements are found, until finally the greatest number is found in the older bodies, such as the planets of our solar system.

This seems to point to the fact that as matter gradually goes through the process of evolution more and more different forms are evolved from some common fundamental base.

The electron theory has, moreover, simplified our concepts of heat, light and electricity. A few years ago there was hardly a scientist who would venture a guess as to the nature of electricity. Now the electron has given us a good foothold in theorizing. The Zeeman effect, cathode rays and other phenomena, have by a reverse process, helped to establish the electron theory and Prof. Millikan of Chicago has actually succeeded in *isolating and measuring the electron itself;* which he found to be about one two-thousandth the size of a hydrogen atom. In static electricity and the study of the various electric tubes, the electron theory is particularly applicable and demonstratable.

The chemist has been in the dark for a long time on the attraction certain elements manifest for other elements, and this he has named *chemical affinity.* The power of uniting he has termed *valence;* and as in water oxygen unites with two parts of hydrogen whose valence is taken as unity, we say the oxygen has consequently a valence of two. The electron theory opens up with renewed interest the question of valence and what it really is. If it depends on the structure of the atom, and all atoms have the same fundamental constitution, only differing in arrangement and number, then valence ought to vary accordingly. If it does not, and it certainly seems that it does not, then evidently the field here is just opening up.

Physical science may be pretty well summed up in the three categories, matter, ether and energy, and artificial as these divisions no doubt are, they serve the purpose to designate three great fields for research. Of matter enough has already been said and of the various forces which await further investigation might be mentioned, adhesion, cohesion, gravitation and magnetism; the last being not the least interesting, indeed.

Regarding *energy,* we know as little about it as anything else, or as Thomas A. Edison has said: "I calculate we know less than the one-ten millionth part about anything." One of the latest theories is known as the Quantum theory proposed by Planck and adhered to in some form or other by a number of scientists. It is to the effect that *energy,* instead of being a continuous and infinitely divisible quantity as heretofore believed, is discontinuous and resolvable into elemental units or atoms of energy. This is similar to our atomic theory of matter and there is good ground for argument on both sides.

Of the *ether* our knowledge is practically nil, except that it transmits light and light waves according to Maxwell as transverse electro-magnetic vibrations. Here again the electron is dragged in with the electro-magnetic theory. The connection between energy, matter and ether seems indissoluble, and the farther we advance in science the more we see how all natural laws work in harmony, and how it resolves that it is our woeful lack of knowledge that causes us to fail to see the relations and infinite truths of nature.

Recent developments in wireless telegraphy and radiation have opened up new fields of investigation, the results of which only aid us the more in former fields. We are now at a place where we are not hampered by a meaningless jumble of phenomena and (empirical and individual mostly in those days) laws, as the scientists of a few centuries ago were. Our general science of physics is fairly well organized and looking out we can see the vast fields open ahead of us.



Showing the Relation of the Basis of Matter, According to the Latest Scientific Theories.

Omegon

By George Frederic Stratton

NED CAWTHORNE, the young millionaire heir of the founder of the great Cawthorne Electrical Works, glared at the half-page caption in the morning paper:

INTENSE EXCITEMENT IN WASHINGTON

Reports That Seventy Thousand Japs and Chinese Have Been Smuggled Into Mexico During the Last Ninety Days

SECRETARY OF WAR ARMSTEAD IMPERATIVELY SUMMONED FROM FLORIDA

Rumor That Mobilization of U. S. Troops Will Commence At Once

He dropped his elbows on the table and his clenched fists against each side of his strong lower jaw.

"We'll be in it, at last!" There was almost a piteous moan in his low, deep voice. "And I—smashed in that accursed polo game—am on the bench."

He straightened up, crashed his fist on the table and growled: "Ever since this fearful struggle in Europe—always with the chance that our country would be drawn into it—I've been ready. I could raise a troop in a week in Idaho and Wyoming. I'd do it, if I had to mount and equip them myself. And now—now, I'm crippled and useless!"

His man, Frohm, entered the room and announced: "Mr. Kilroth, sir!"

Cawthorne glanced at the big, sturdy mechanic who followed. Then he limped forward with a cordially outstretched hand.

"We know each other by sight, no doubt, Mr. Kilroth; but I've never exchanged any words with you, I think."

"You've seen me in the works, sir. They call me a shop inventor."

"And you have something to submit to me, Kilroth?"

"Yes. The men and the engineers know well how you feel about this war and what you'd like to do; and I've heard of something—a big thing—you can do if you care to put in the money and give orders."

He glanced at Cawthorne, who, with clenched jaws and fiercely flashing eyes, nodded imperatively.

"It's no invention of mine, sir, but I've heard of it and looked into it. It's a submarine invented several years ago. It will run under an armored vessel, and in twenty minutes, or less, all action on that vessel will cease, although no lives need be sacrificed and no damage done to the ship."

Cawthorne's fist crashed down on the table. "If it will do that, Kilroth, why has it not been developed?"

"It doesn't kill," retorted the machinist. "It's been offered to the Government and turned down, flat. It's too small and unimpressive! It's only forty feet long and hasn't got a death-dealing implement on board. Its purpose is persuasion, not annihilation, and the War Department don't take any stock in that kind of stunt."

"Where is it?" demanded Cawthorne.

"There's a model in Providence, and full drawings. The inventor, Wheaton, is a Providence man."

"Can we see it—and when?"

"To-day, if we were there, Mr. Cawthorne."

"We'll be there!" He picked up his house phone, called the hangar, and directed:

"Wansted! Get that gyroplane ready for a trip, at once. Just three or four hundred miles." Then turning to Kilroth:

"You can go, I suppose?"

"Certainly, sir."

The elder Cawthorne's grasp on gigantic industrial exploitations and the financial projects which backed them had notoriously come from his marvelously rapid decisions and determinate action; and Ned was his father's son. The flight over to Providence, the interview with Wheaton and the convincing enthusiasm of the machinist, Kilroth, resulted on that same day in a decision to build some of those submarines. Ned spent a week in placing orders, at several great plants for the shells of the boats and for the various parts of the machinery and equipment. Then he dashed across the continent and secured a large water-front warehouse for the assembling and launching of the boats.

The magic of the Cawthorne name and the two hundred millions back of it, with Ned's evident disregard of cost, resulted in astounding speed in those great shops, and several cars of apparatus were being rushed west by special train when war with the Japo-Chinese alliance was declared.

Kilroth engaged a number of the finest machinists from among his very extensive acquaintance, but not one was informed clearly of the work to be done.

"It's assembling machinery over in San Francisco," he stated. "You'll get triple pay and all expenses; but you'll have to stay and live in the shop till the job's finished. The doors'll be locked when you go in, and they'll stay locked till we're through. Even your mail will be censored! If that doesn't suit you, don't go."

SUPPOSE that some first-class foreign power declares war on us to-morrow. Also suppose that we are outclassed in battleships—we are only the fourth strongest naval power to-day—what would happen? Would American genius prevail? Would our inventors rise to the occasion? Could we annihilate a powerful fleet as suggested in this story? Read this brilliant tale and judge for yourself. It will fire your imagination and it will thrill you, as few stories can.

And, amid all the tremendous excitement of preparation for war, the rush of troops to the Mexican border and the rush of battleships through the canal and along the Pacific Coast, the mystery of the big, sealed-up warehouse in Oakland excited intense speculation from coast to coast. News correspondents made frantic and futile efforts to get admission to the building or into touch with some workman, but the only man who ever responded to the demands at the entrance was Kilroth.

"Nothin' doing!" he'd grin through the small wicket. "You'll have to see Mr. Cawthorne."

That gentleman invariably received them with hearty smiles, cigars and: "Oh, well, boys! Of course you know we're working on some small—very small—submarines; just experimental models, in fact. If they show any promise I shall invite the naval authorities to look at them."

And when the naval authorities were invited to inspect the boats a young lieutenant was sent to the shops. He glanced superciliously at the five miniature boats ranged along the length of the floor and, with a touch of sarcasm in his tones, said:

"A bit small for present warfare, Mr. Cawthorne. The total length of those five boats is considerably less than any one of the new boats they're laying down at the Fore River shipyard."

Ned laughed: "Sometimes machines are like men; the size is no indication of efficiency, lieutenant."

"Possibly so, in industrial matters. But making cotton-cloth or—er—arc lamps is not warfare. It's weight counts there. That last battleship the Japs put into commission is fifteen feet longer than any we've got, and her guns are three millimeters larger caliber. That's what we've got to meet."

Ned shrugged his shoulders. "Examine the principle of this boat. See those great electro-magnets on the deck? When we run under a battleship those magnets will be switched in and hold this little forty-foot submarine as fast against the great hulk as if she was bolted. Each magnet has a pull of 20,000 pounds! Now! Look at these guns pointing straight up from the interior of the boat. Just a little two and a half-inch bore, but they use the new Trotal gelatin explosive. They put as much power behind a bolt as the most modern fourteen-inch gun you've got. Let's go inside!"

They descended through the deck manhole, and in the ample light of electric bulbs the lieutenant saw two bulkheads—the doors open. Aft was the 300-horsepower Hargreaves motor, its aluminum casing and duplex wiring weighing only one-quarter as much as the ordinary motor of the same power.

"Our current is from the marvelous Edison-Seabright storage culminator," explained Ned. "No compressed air to heat up things. The voltage is 2,000, and there's juice enough to run us 600 miles."

The middle compartment contained the controlling mechanism, the gauges, air and pressure valves, and, overhead, the collapsible conning tower. Forward were the breeches of the two Tobin bronze guns, and tapped into each was a flexible tube connecting with chemical tanks overhead.

The lieutenant pursed his lips. "The department has seen drawings of all this before, Mr. Cawthorne. Ingenious, and all that, but giving no indication of practicability."

Cawthorne exploded: "No indication of practicability! How can such a demonstration be made except in actual use?"

"Ah, yes. Of course! But, don't you

see, my dear Cawthorne, that this is no time for experimentation? We have got to fight the real things, and must have the real things to fight with. I should advise you to make a test on some hulk. There's quite a number of played-out tramp steamers laid up here."

Ned's face crimsoned with riotous indignation and a hot retort sprang to his lips, but the lieutenant had stepped to the manhole ladder and started to ascend. He paused on the lower rung and continued:

"Of course, all that is only my opinion, Mr. Cawthorne. I shall make a full report of this, and you will probably hear from my superior officers regarding it."

But as quickly as the hot wave of rage had swept over Ned so quickly it departed, and in its place came a flashing gleam of inspiration. "That hulk!" he muttered, as he skilfully worked his false leg up the ladder steps. "This little lieutenant has put me on the track of success far more than he thinks!

He waved his hand to the departing officer, stumped over to a shed and ran out his roadster. Before that day was out he had signed a check for $120,000 for a laid-up tramp steamer, formerly in the Columbia River lumber trade.

And that evening San Francisco was wild with excitement and alarm over the telegrams:

"Seven Japo-Chinese superdreadnaughts crossing the Pacific, headed for San Francisco. Six others have left Mexico and are steaming north."

Cawthorne dashed down to the big warehouse and got Kilroth into the eight-by-ten den they used for consultation.

"How soon can we run those boats out?" he demanded.

"Three days! There's a conducting wire all ready for charging our culminators and the tanks are connected up, ready for the chemicals."

"Yes!" retorted Cawthorne grimly. "And do you know what we're up against now? That naval expert who was here this morning has nothing but sneers for our boats. They're not large enough to consider. Now, Kilroth, unless we man those boats ourselves, and fight them ourselves, they'll stay right here on the floor. I haven't the faintest hope that the naval authorities will put them in commission!"

"I never had!" grinned Kilroth. "But we can handle them. We'll need three men for each boat—four would be better—and we can get the right fellows from our gang here. They don't know how to present arms and salute a dinky little West Pointer properly, but they'll put those boats just where we built them to be put, mark me, Mr. Cawthorne."

Ned grinned confidently "I'm sure of it!" Then he told of the lieutenant's suggestion to test the submarines on some old hulk.

"I bought the hulk to-day," he laughed. "Not to test the submarines—we'll do that on a Jap dreadnaught—but as a tender. See! She's a pretty fair boat. Now, here's my plan: If the authorities here knew that we were going out to meet the enemy they'd stop us completely; but they're not going to know it until it's done. We'll state that we're going up the coast to test the boats, and we'll start up that way; but after we've run a hundred miles north we'll change into the west and run out into the Pacific and intercept those Japs seventy or eighty miles from San Francisco. Our steamship will cover our approach, will tow us out until she is challenged, and save our power. Then we'll drop our submarines below the surface and go for them."

"That's a scheme, all right," grinned Kilroth. "An innocent looking little scheme that hasn't got any 14-inch guns poking out in front of it."

"Select the men we need," muttered Ned. "Tell them just what we're going into, and that I'll guarantee them a couple of thousand dollars each for the adventure—win or lose. And there may be prize money! If so, it will be big—very big! Now, I've got to select a captain for that hulk—the *Sarah Quimby*."

Four days later the *Sarah Q.* steamed out of San Francisco Bay, and grouped at her stern were the five submarines, decks awash, the tiny conning towers barely visible. They ran up the coast to Gualala, and while the *Sarah Q.* lay at anchor the submarines made below-the-surface cruises, testing out men and equipment.

There were two days of that. Then came, through the Gualala telegraph office, a code message from San Francisco, sent by one of Cawthorne's trusted mechanics, and which Ned interpreted as:

"Wireless from outlying scout cruisers—Jap vessels 200 miles west."

He handed that to Pat Mulray, the new captain of the tramp steamer, and that blue-eyed, red-haired mariner gleamed with joyful anticipation.

"If we start at once, Mr. Cawthorne, we'll cut 'em off a hundred miles out of 'Frisco Bay. That'll be about right, won't it?"

"It sure will, Captain. Admiral Sangster's squadron won't run out as far as that to meet them. He's got to keep near the coast to watch those other Jap ships which are working up from Mexico. Now, you've got it all clear. Run across the line of the enemy's ships. They'll challenge you as soon as you get within five miles—perhaps before. Then you'll lower your flag and stop. They'll send a prize crew aboard, I suppose, and make you and your crew prisoners; but about that time we'll be busy."

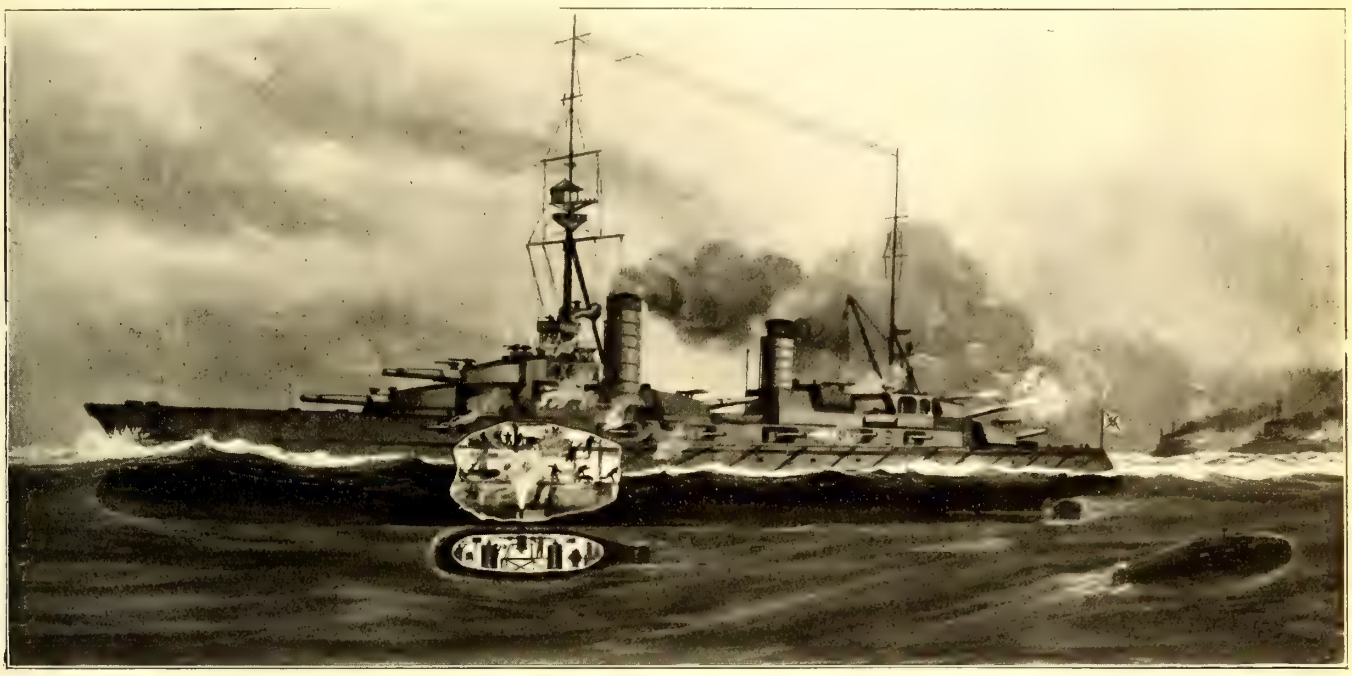
"Glory be! I'd like to be goin' wid yez, Mr. Cawthorne. It's against the grain to be lowerin' the flag to those little brown divils."

"It's the strategy of war, Captain. You'll have the laugh on them a little later."

They steamed out, due west, the conning towers of the submarines just above water, but hidden along the side of the *Sarah Q.* At noon two cruisers, which had been watching outside, were working back toward the coast. They sent an imperative wireless message:

"Turn back! The enemy's battleships are coming in." To which Captain Mulray returned:

"Thanks. Going due south. Will be across before they get here." And for 20 minutes he changed his course so as to avoid any interference from those cruisers.



The gun piston had plunged through the bottom plating of the ship, carrying with it the Omegon ether injection tube.

Then he swung her head again into the west and ran at full speed.

When within 10 miles of the coming vessels Cawthorne gave the order:

"Drop below!" and in a few moments the conning towers had disappeared. At 16 feet below the surface the boats kept together, running at full speed. Ned's boat, No. 3, was in communication with each of the others by means of the new hydrophones which were perfected to an underwater radius of 5,000 yards, and his aerial televisor, floating like a little toy balloon 20 feet above the surface of the water, was showing on the marvelous electric screen below the positions of the battleships.

"They're running half speed!" he exclaimed, exultantly. "Look at the funnels! No forced draft there! I'll bet they are holding back so that their southern squadron'll reach San Francisco when they do. That'll give them 13 ships against Sangster's 11."

When within two miles of the ships the televisors were hauled down. Ned gave his last orders to the other boats, and each started independently on its mission. They darted through the smooth subsurface at full speed, and in less than five minutes the magneto-detector in Cawthorne's boat showed the nearness of a mass of steel, its needle pointing accurately to that mass. Ned steered to one side of his prey, swung sharply around and darted under the monster—the flagship of the Japo-Chinese alliance and the most furious hell of destruction ever constructed by man.

"Half speed!" he yelled, and Bundy slipped the controlling lever over. Wheatly, the third man, stood by the submerging wheel.

"Up—easy!" commanded Cawthorne. Then he sprang to the forward magnet while Bundy jumped for the other, and there was a dull thud and scraping sound as the magnets of the submarine came up into contact with the bottom of the *Matzuma.*

"Hold her!" he shouted, and threw his switch, and the distinct jar and click showed that the connection was made.

Cawthorne peered from the bullseye in the tiny lookout, just large enough to take his head, and he threw on the concentrated electro-magnese ray. "Pretty well forward," he muttered. "Jump for that forward gun, Bundy! Fire it!" and the next moment there was a crash which jarred every rivet in the boat. *The gun piston had plunged through the bottom plating of the ship, carrying with it the injection tube.*

"Stand by that pressure valve! Let her go!"

Wheatly swung the valve, opening connection to the chemical tank above and forcing the *Omegon* ether, under 300 pounds pressure, through the gun piston tube into the bowels of the great superdreadnaught. Cawthorne stepped to the pressure gauge and watched it for eight minutes, which seemed like eight days to the other men. Then, his face grinning through a flood of sweat, he exclaimed:

"We'll give them the other tank in the other end now. Stand by those magnet switches! Throw 'em out!"

The great magnets went out of commission and Cawthorne threw in the propeller switch, casting off so as to permit the submarine to slip along the bottom of the battleship toward the stern. Suddenly he yelled, "Hold her!" and again the magnets took their bull-dog grip on the steel plating.

Again and again came the fearful crash of the great guns above them. "They're firing on the cruisers, I guess," grunted Ned. "Let 'em have that other gun, Bundy!" and he sprang to the pressure valve. The operation on the forward end of the ship was repeated aft, and as Cawthorne's eyes were fastened on the gauge, Wheatly exclaimed:

"It's getting in its work, Cawthorne! The for'rd guns are silent!"

"Well, we've done all we can," grinned Ned. "Let's get out of this!"

Again the magnets were switched off, the propeller motors put into action, and the nose of the submarine pointed down as they darted away from the bottom of the huge dreadnaught.

They ran for two miles before raising the televisor. Then it was allowed to float up to the limit of its 40-foot cable. Cawthorne's eyes were fixed on the wonderful screen which revealed all that the televisic eye above saw. Wheatly stood by him, every nerve tingling with excitement.

"The *Matzuma's* engines are stopped!" he half yelled. "See those funnels!"

"There's the *Sarah Q.!*" grinned Cawthorne, as the televisor was slowly revolved. "Flying the Japo-Chinese flag, too! They took possession of her pretty quick. I wonder what Captain Mulray's doing?"

MÜNCHHAUSEN?

YES, how about him, what happened to the old boy? Was he really struck by a meteor and was he killed? No, dear readers, nothing of the sort happened. Meteors may be fast, but not fast enough to catch our beloved Baron, no sir.

To explain: When the usual installment did not arrive from our far famed correspondent, I. M. Alier, of Yankton, we sent him several urgent wireless messages. Here is his answer:

Editor E.E., New York:

Sorry no installment this month. Münchhausen and Prof. Flitternix left for Planet Mars in their "Interstellar" some time ago. Will return to Moon, Sept. 10th. Expect sensational story. Hold presses till last moment to catch October issue.

I. M. ALIER.

The above explains it. If everything goes well, we ought to print a wonderful story in the October issue. We're kind of excited to know what's doin' on Mars, aren't you? Better order your October issue now.

"Our battleships are coming up!" he added after a short pause. "If our submarines didn't get in their work there'll be a fight, right out here. But four of the enemy's vessels are not steaming, and our cruisers are falling back to meet Sangster's ships. I guess we'll fall back too, Wheatly. We ought to report what we've done so that the Admiral can follow it up."

They headed back east at full speed, and in a few minutes were near the *Texas,* which was turning her propellers just sufficient to give her steerage way. Flying the Stars and Stripes from the aerial mast, Cawthorne put his short wireless into action.

"*Texas:* Can I come alongside and report? Our submarines have been in action and have silenced four of the enemy's ships, I think."

There was a few minutes' delay. Then came the answer: "Come alongside."

Five minutes later Ned climbed onto the deck of the cruiser and faced the lieutenant who had inspected his boats.

"We have discharged our Omegon ether into the *Matzuma,*" he exclaimed, "and I believe, from the appearance of the enemy's ships, that three of the other submarines have done the same!"

"Good Lord!" ejaculated the officer, "is that what it means? Come aft, Mr. Cawthorne, and report to the Commander."

He was taken to the bridge and again stated what he had done. Commander Preston made no comment, except: "Four of their boats are out of action—are not even steaming. Mr. Pearsall! Direct the wireless officer to report this information to the Admiral. Mr. Cawthorne, go onto the main deck, or below, if you wish. One of their vessels is getting our range."

He went to the deck, and as he reached there a fearful, ear-splitting crash broke out astern. Staggering around, he saw the gigantic *Arizona* about a mile away. Then a hand was clapped on his shoulder and a deep voice said:

"Mr. Cawthorne, I believe?"

It was the ship's surgeon. Without waiting for a reply, he went on: "Something extraordinary has happened, or is happening. Three or four of the enemy's ships are out of action, and our Commander has just been signaled to send a prize crew aboard the *Matzuma.*"

"The *Matzuma!* The vessel we put to sleep?"

"Evidently. Her flag is down." Then, after a long glance through his binoculars, he added: "I make out two other ships—flags down!"

"Then my submarines did get in some work," muttered Ned. "I'd give a million to hear from them—to learn if they are safe. Surgeon, is there a bare possibility of calling Gualala? I ordered those boats to run back there when they got through."

The officer shrugged his shoulders. "I think we all feel curious about that. Stay here, Mr. Cawthorne. I'll see the Commander."

In a few minutes he was back. "The Commander has ordered communication with Gualala. He's as eager as you to know how your men and boats have come through. It's marvelous, simply marvelous! Five of those tremendous new superdreadnaughts have surrendered without landing a shot! Most of the firing came from the two which our ships are now chasing! Here comes our launch—the one that took the prize crew out to the *Matzuma.*"

And as the officer in command of the launch came on board he was followed by Pat Mulray, captain of the *Sarah Q.* Utterly indifferent to the uniformed men about him and the officers on the bridge, he made for Cawthorne in an Irish hornpipe step which was a revelation of irrepressible overwhelming joy.

"Glory be! Man, dear, yez did it! Hould on, now! Hould on! I'll tell yez all about it if ye'll let me lay me own course. Whin the *Matzuma* sint a launch over to take possession of the *Sarah Q.* they had orders to take me back to the flagship. So I wint. Whin I got there they began askin' me about th' little *Sarah,* an' what I was doin' wid her out there. But divil a wor-rd about th' submarines. They knew nothin' of thim, at that toime; but they got th' knowledge of thim without askin' me. Before they asked me more than twinty questions an' got th' neat little lies I had ready for 'em, the for'rd guns stopped firin' an' th' officers an' deck crew were tearin' 'round, crazy as hornets. They opened some hatches an' jumped in, an' came out again carryin' out men as limp as dead eels, an' laid 'em 'round th' turret base like bars in a capstan.

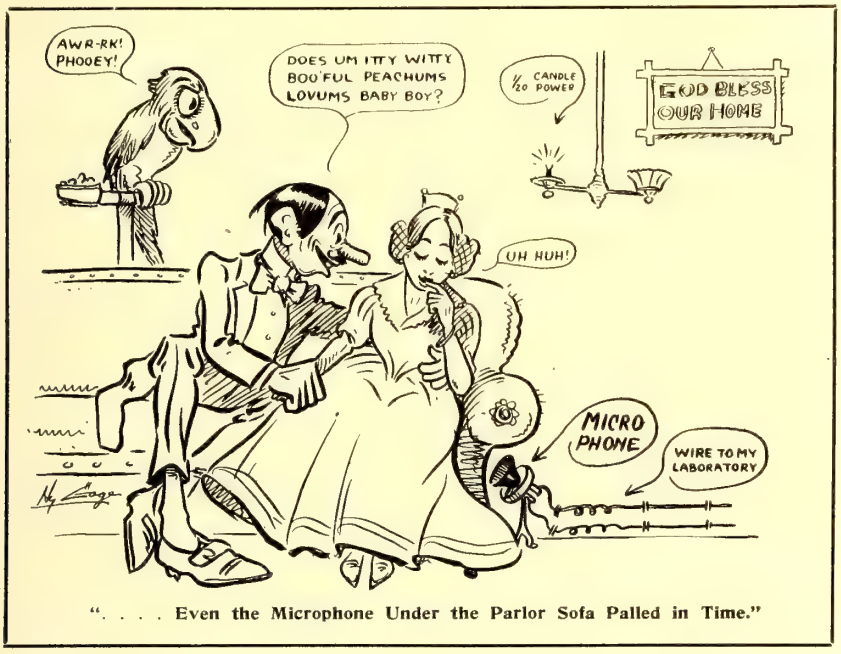
(*Continued on page* 237.)

The Old "Bug" Speaks

By Thomas Reed

IN many hearts the warmest spot is reserved for the boy experimenter, the "scientific bug." In mine that spot is so large that it threatens to include the entire organ. Do I know anything about bugdom? Listen.

The youthful bug is always poor. His scanty finances have to be spread as thin as a coat of paint over the vast area of his desires. How we envied the lot of the fortunate exception, the boy whose parents "encouraged" his taste, giving him unstined "dough" wherewith he acquired "boughten" instruments, driving us to what in later years would be drink. Long, long afterwards we knew that the favored child of fortune was missing all the fun of the thing. Once the oh's and ah's of the have-nots had died away he had nothing to do but turn his nickeled handles and grow tired of his toy; while we progressed from one triumph to another, conquering not only the forces of nature, but the attacks of "outrageous fortune." The first was easier than the second.



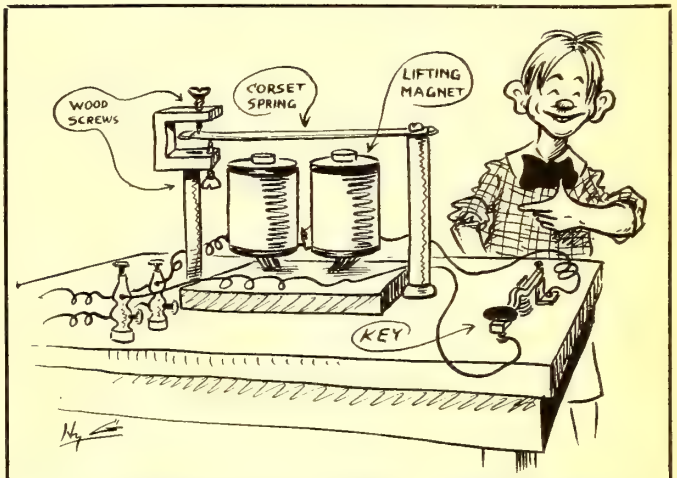
". . . . Even the Microphone Under the Parlor Sofa Palled in Time."

Bits of material and parts from other mechanisms were our hoarded wealth. Clock movements and curtain rollers were mines of opportunity. Broken electric light carbons and sheets of lead-foil from the tea-chest were what the solemn ones call "mediums of exchange." Feminine finery helped the cause—what should we have done without the trusty corset steel? It was supplemented in my day by the flat wires of the last of the hoop-skirts, ravished from its dusty retirement in the attic.

With us it was not to copy, but to extract the principle and adapt to it such material as we had. My first sounder was a big lifting magnet, with an armature of that corset steel of grateful memory, all imbedded in a wooden block with an adjustment contrived of wood screws. It resembled no sounder since the days of Morse, but it worked.

It was in the days of my early *bughood* that the telephone swam into the ken of a waiting world, surrounded by an awesome halo of patent suits. We used to tremble at the step of the policeman on the beat, apprehensive of what the American Bell Telephone Company would do to us if they should catch us with the goods—our poor little wooden receivers made in defiance of the great seal on those patents; but somehow we escaped the felon's cell.

It was the telephone that first broadened the horizon of us bugs. Before that there was only the telegraph, electric bells to ring for purposes supposed to be useful, electric clocks and such like. Oh, yes, an electric wind-vane; to be sure, there was already a vane on a barn in full view of my window, but I persuaded myself mine was more accurate. The telephone began to realize the ideal which has attained its full glory in the wireless. It was a really delicate instrument, yet so easy to make as almost to defy the possibility of failure. Bugdom was elated when its first pair of receivers transmitted words, not only perfectly, but with the individual characteristics of the voice; but given a magnet, a little coil of wire and a diaphragm, and it would tax the stupidity of the head bungler from Bungleville to make one that would not work.



My First Telegraph Sounder Comprised a "Lifting Magnet" of Heroic Size, Together With a Corset Spring and Some Wood Screws.

Of course, I am a wireless bug to-day; but I sometimes wonder, looking back to the lean old times, if the present buglets realize what a seventh heaven they were born into by wisely postponing their birth date till now. Our old machines seemed somehow to lack a vital use. The electric bell that repeated in our room the blows of the kitchen clock was entertaining, but superfluous. The telephone and telegraph once perfected we found it a bore to think of something to say. The wind vane, rain gauge, etc., recorded only slow processes of nature; it was a long wait between changes. The electric clock was good, but monotonous. Even the microphone under the parlor sofa palled in time; variety again was lacking. We yearned for something that, once in operation, would bring us returns from the outer world—continuous, changing, worth while—and there was nothing till the wireless came.

But now what a paradise for the patient bug! Instruments, the coil, the detector, the condenser, within the power of anyone to make. And once made, like the glittering paraphernalia of the wizard, they open a wide door into a new world. You push your sliders, turn your switches, feel for that elusive sensitive spot on your galena, and presto! "the world is all before you where to choose." You hear the fussing of the amateurs from near and far with "O. M.," "C. U. L." and "How is my wave now?" The crisp, abbreviated messages between ships and from ship to shore—here comes the Campania, the Lusitania (alas, no more) just on time, and what a babble is exchanging of "Greeting" and "Love" and "Meet you at the dock."

Here is the weather forecast for to-morrow, hot off the griddle at the navy yard; almost equally important, the baseball scores after the playing is finished for the day. The correct time, straight from old Father Time himself at Washington. The weather conditions in their simple code from a dozen stations; the "winds for Tuesday and Wednesday—North Atl., Middle Atl.," and all around to the Great Lakes Some times the brief, grim tale of an "obstruction to navigation"—an iceberg, a waterlogged schooner in such and such a latitude and longitude. Careful Grandma Wellfleet with her "latest news of the day" —what a boon at the summer camp, where the morning paper will not come in till afternoon, if it comes at all! And so on till the German station starts its all-night toil, rapid, nervous, now in German words, now in English, pouring urgent messages over an iron-bound frontier and a zone of desolation and death.

ELECTRICAL EXPORTS TO ARGENTINE REPUBLIC.

May exports of Argentina from the port of New York included $63,000 worth of electrical supplies. To Brazil, there was sent in May from New York, $34,000 worth of electrical material and supplies.

WHAT IS A WATT?

By P. W. Pelts.

The writer has been asked so often, "How many volts is in an ampere?" and, "What is a kilowatt?" that he has thought of mimeographing the answers and carrying them around in his pocket. However, since the *Electrical Experimenter* is read by practically everyone interested in the subject, a contribution to this excellent magazine would be more far reaching than the typewritten copies would be.

Although we can neither see nor hear the electric current, still it is just as easily handled and utilized as a water fall. Both are sources of energy; both can do work. You can buy and sell the one, just as easily as you can the other. Either can be parcelled off in small packages or sold in job lots. The electric energy can be packed away in small jars and set up on the shelf to "keep," or it may be shot off along a pair of slender metallic threads, to run the shops and street cars of a city three hundred miles away and also light its streets and homes.

Water is sold by the cubic foot or by the gallon. One way or the other, it is a definite quantity, at a definite price. Electricity is sold by the AMPERE*, just as we sell water by the gallon; an AMPERE of current therefore is just "so much." One horse drinks half a gallon of water; twelve horses drink six gallons. One lamp takes half an ampere of current; and twelve lamps require six amperes. A little pony could drink but a small fraction of the gallon, so also a small lamp can take in only a small part of an ampere. A twenty-five watt Mazda lamp uses about one-fourth of an ampere and the 100-watt lamp uses almost a full ampere. An arc-lamp requires from six to ten amperes.

It is well known that some substances will carry the electric current better than others. Silver is one of the very best conductors, with copper a close second. Iron is rather poor, lead is worse, while German silver and Mercury bring up the rear as conductors. Substances that are poor conductors push back against the oncoming current. This ability of a conductor to retard the flow of a current through it, is called resistance, and it is measured in ohms.

A water pipe of small diameter will deliver much less water in a given time than one of larger diameter, although both be connected to the same tank or reservoir. This is because of the resistance offered by the sides of the pipe to the flow of the water. An exactly similar condition exists in an electric circuit. A wire one-fourth of an inch in diameter will offer much less resistance to the flow of an electric current than a wire only one-eighth of an inch in diameter, consequently more amperes of current will flow through the larger wire than through the smaller.

As was said before, the resistance which a substance offers to the flow of electricity is measured in OHMS. The standard OHM is that resistance offered by a column of mercury 106.3 centimeters in length, and one square millimeter in cross-section at 0 degrees C. This is equivalent to a length of mercury 41 4/5 inches and 155/100,000 square inches in area. 9.35 feet of No. 30 copper wire and 6.2 inches of No. 30 German silver wire have the same resistance. 93.5 feet of No. 30 copper wire would have a resistance of 10 OHMS, which would be just the same as 62 inches of German silver wire of the same thickness.

From the above it will be seen that the resistance of a conductor increases with its length and decreases with its diameter, also, that different substances offer different amounts of resistance.

Now since all conductors possess this quality of resistance, and this means that they are able to push back against the oncoming current, we must use force or pressure to push our amperes of current through the conductors so that they may be of use where they are wanted. Take the case of a 55-watt Mazda lamp. The little hair-like filament of this lamp is very small indeed and possesses 220 units of resistance or OHMS. To heat up this filament to full brilliancy we must send through it half an ampere of current. In order to get our half ampere through the lamp we must exert a push or force greater than the backward push (or electrical inertia) exerted by the lamp filament. This force which pushes our half ampere through the lamp, can be measured just the same as the force or pressure of a steam boiler. The unit of this electrical force is the VOLT and it is equal to about two-thirds of the force which can be exerted by an ordinary dry-cell. In other words a single dry cell can furnish a pressure or force of about one and a half VOLTS. It has been found by experiment that the pressure required to force half an ampere through the above mentioned Mazda lamp, is about 110 VOLTS.

Ohm's Law is a formula which enables us to tell what pressure is required in any case, when we know the current and resistance. It is written as follows: VOLTS equals AMPERES times OHMS. ½ AMPERE times 220 OHMS equals 110 VOLTS. If we know the electrical pressure furnished by the power company, and the resistance of a circuit, we can tell before hand how much current will flow. To do this we can transpose the factors in the above formula, so that it will read: AMPERES equal VOLTS divided by OHMS. Thus it is that 110 VOLTS divided by 220 OHMS gives us ½ AMPERE.

Since the power company has to furnish us with the amperes of current to light our lamps, and also the pressure to force the amperes through the lamps, they are going to charge us for both the VOLTS and the AMPERES. Edison's first electricity meters measured only the AMPERES that ran into the customer's lamps, then the bookkeepers in the office had to figure out the rest of the bill. The modern meter, however, measures both AMPERES and VOLTS. In fact it multiplies one by the other and gives the answer in WATTS. A WATT, then, is a VOLT times an AMPERE, and is the unit of power. Half an ampere of current flowing into the lamp for one hour, forced through the lamp by a pressure of 110 volts, gives us 55 watt-hours. If the electric company charges at the rate of 1/100 cent per watt-hour (which is the same as 10 cents per kilowatt-hour) our bill for burning the Mazda lamp for one hour is approximately ½ cent. Thus the consumer of electrical energy will have some idea of how his watt-hour meter "adds up his bill."

[*Not strictly speaking; the watt is the unit of electrical energy. See the author's later paragraphs.—Editor.]

THE WRAITH OF THE WIRELESS

By Rose Seelye-Miller.

I was a voice enthralled,
And at command I called
Over the sea, where the white ships ply
Over gray icebergs, through foggy sky;
Sharply or softly, the vibrant air
Carried my message, shriek, or prayer.

Chanted the watchman, "All is well."
A crash! Pandemonium! Hurry! Hell!
My master's hand clutched at my vibrant throat;
Choking, I hurtled a single note—
In a mad, metallic S. O. S.
I shrieked out my signal of distress.
S. O. S.! S. O. S.! S. O. S.!
I shrilled and I prayed in wildest stress,
Save our souls! Save our souls! Save, Oh, Save!
From the iceberg ghouls and the deep sea grave!

Save! But the hand that hurled me wide
Fell from duty to death in an awful tide.
My Master's power was too weak to save
A mighty horde from a mightier wave.
Had I been mortal, my throat with Death
Would have choked and rattled with frigid breath.

But I live, and Master, Master, I fly
Over fields of ice, through foggy sky,
Futile, finite, hushed and stilled,
Without thy hand that touched and thrilled.
I'm a wandering wraith, without control,
For my voice went out with my Master's Soul.

Some time, somewhere, in infinite light,
I shall answer again to my Master's might.
Neither futile, nor finite, then will be
His hand with its perfect mastery.

EDITOR'S CHAT

We sincerely hope that you will like this issue. Containing as it does 144 illustrations and 128 different articles, it is without a doubt the largest and most complete popular electrical magazine ever printed in this country. No expense was spared to produce this big issue which is the equivalent of an 128-page standard-size magazine. But while it may satisfy you, we are not as yet at the end of our efforts. We will try hard to surpass this number; indeed the coming October issue will even be better.

There will be several big feature articles, several new "cracker jack" stories, including "Münchhausen" on the Planet Mars. There will be a wonderful article for the Constructor and a bunch of new wireless articles to gladden your heart.

But before we forget it: This issue is so big only due to our advertisers. You must thank them rather than us. You cannot show your appreciation better than by writing for their literature and by patronizing them to the fullest extent. Only—and only so—can we enlarge the magazine still further. It's up to YOU.

And before we forget, order your October issue early, NOW.

Massachusetts students of wireless have had good success with experiments in sending and receiving messages with aerials laid on the ground.

Luna Park, New York's "Joyland"

WHEN the proverbially tired business man of the great metropolis of New York looks about for a place in which to clear away his worries, he invariably jaunts forth to that "Mecca" of all pleasure seekers in the "Eastern" United States, Luna Park. Some of the beautiful effects attained in the arrangement of the electric lighting of this playground of playgrounds may be partially gleaned from the accompanying views.

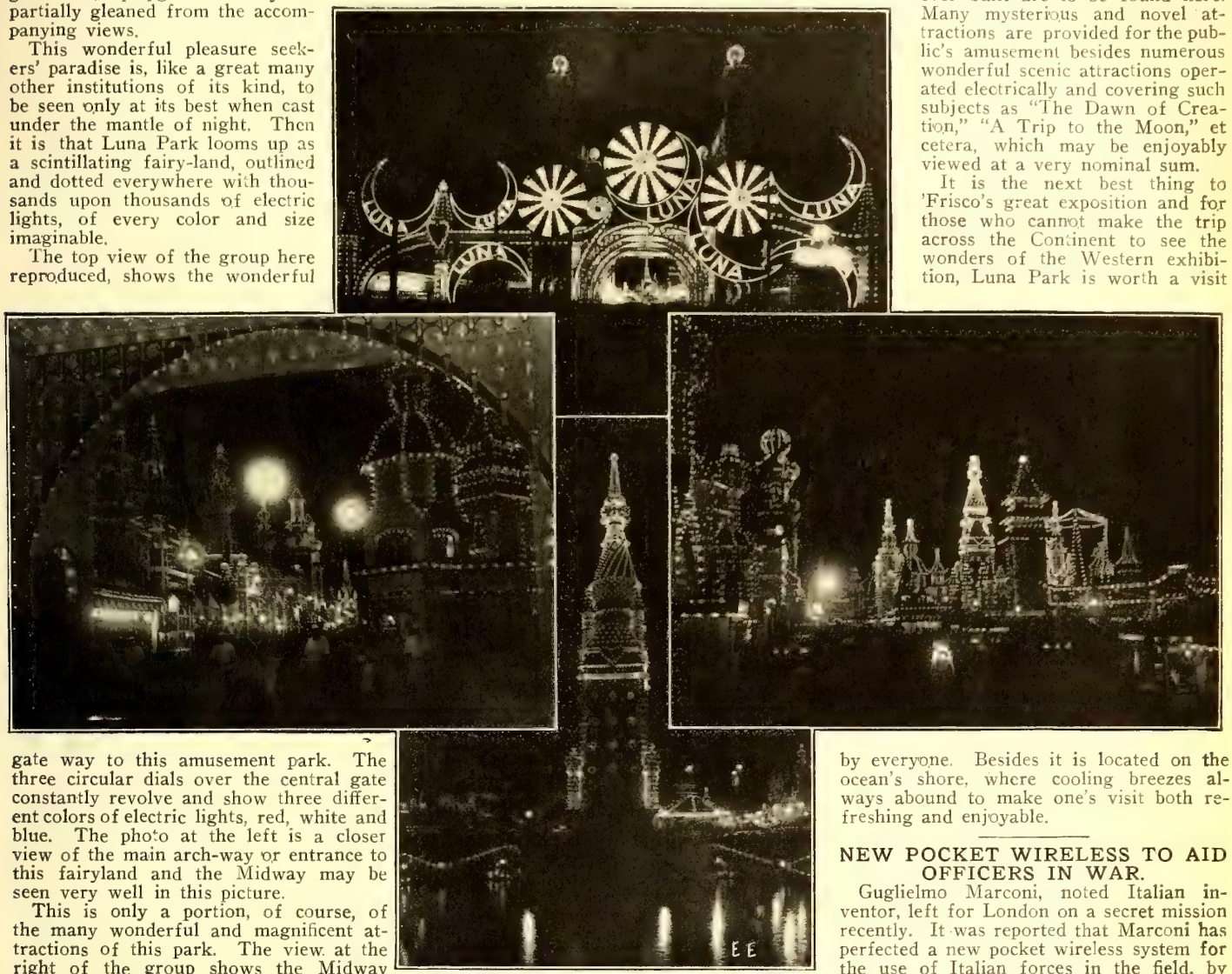
This wonderful pleasure seekers' paradise is, like a great many other institutions of its kind, to be seen only at its best when cast under the mantle of night. Then it is that Luna Park looms up as a scintillating fairy-land, outlined and dotted everywhere with thousands upon thousands of electric lights, of every color and size imaginable.

The top view of the group here reproduced, shows the wonderful minarets of Luna Park at night.

The lower central photo shows The Tower of Jewels, which is garbed in a handsome manner with thousands of electric bulbs and as this is situated alongside one of the lakes or lagoons of the pleasure ground, the reflection and general scenic effect at night is very entrancing and decidedly oriental. In fact, this seems to be the underlying theme in the general arrangement and architectural layout of Luna Park. This oriental effect, to be sure, gives a bewitching charm and quaintness not easily duplicated otherwise.

There are a great many interesting attractions to be found here, which depend mostly for their operation upon electricity. The largest scenic railways and the like ever built are to be found here. Many mysterious and novel attractions are provided for the public's amusement besides numerous wonderful scenic attractions operated electrically and covering such subjects as "The Dawn of Creation," "A Trip to the Moon," et cetera, which may be enjoyably viewed at a very nominal sum.

It is the next best thing to 'Frisco's great exposition and for those who cannot make the trip across the Continent to see the wonders of the Western exhibition, Luna Park is worth a visit by everyone. Besides it is located on the ocean's shore, where cooling breezes always abound to make one's visit both refreshing and enjoyable.



Views of the Beautiful Night Illumination at Luna Park, New York.

gate way to this amusement park. The three circular dials over the central gate constantly revolve and show three different colors of electric lights, red, white and blue. The photo at the left is a closer view of the main arch-way or entrance to this fairyland and the Midway may be seen very well in this picture.

This is only a portion, of course, of the many wonderful and magnificent attractions of this park. The view at the right of the group shows the Midway more in detail and here can be seen the many beautiful illuminated towers and

NEW POCKET WIRELESS TO AID OFFICERS IN WAR.

Guglielmo Marconi, noted Italian inventor, left for London on a secret mission recently. It was reported that Marconi has perfected a new pocket wireless system for the use of Italian forces in the field, by which officers at the front can keep in touch with headquarters all the time.

UNCLE SAM WILL HAVE ELECTRIC BATTLESHIP.

The first electric battleship will be added to the United States navy in two years. It is the California, which is to be built at the Brooklyn Navy Yard at a cost of $7,000,000. It will also be the largest battleship yet built for our navy—624 feet long and 97 feet wide, with a displacement of 32,000 tons and a speed of 21 knots.

Its main battery will be 12-inch guns. It will have a torpedo defense battery, which the European war has shown to be of great importance. This battery will have 22 5-inch guns.

Inventors have long dreamed of an electric battleship. With the California this will be realized and with it we lead the world, just as we led it by the device of "central fire"—that is, having the heavy guns over the keel instead of at the sides—a device that the new European battleships have copied.

In the California there will be no directly connected turbines. The power will be transmitted to the four screw propellers through slow-speed motors which will relieve much of the strain on the crank shaft. The electric power installation will consist of two separate plants, each furnishing power for two screws. If desirable the ship can be operated on one generator. Electricity provides the smoothest and most flexible method known of propelling, steering and operating a ship.

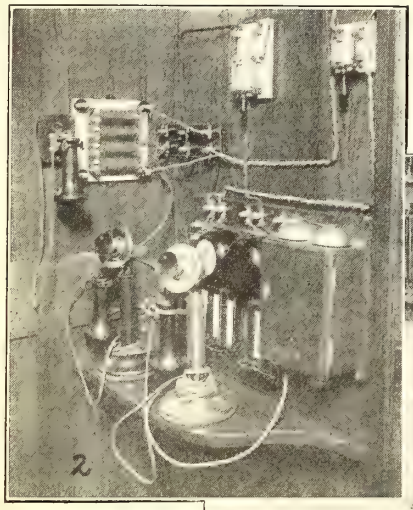
WEATHER BY INTER-CITY WIRELESS.

Advices received recently from Cincinnati stated that weather bureaus of that city and Pittsburgh would soon exchange information by wireless. The announcement was reported to have been made by Weather Forecaster W. C. Devereau, of Cincinnati, that preliminary arrangements for the installation of the service were made at a conference between Mr. Devereau and Henry M. Rubel, Jr., who is installing a station at Cincinnati. Mr. Rubel is said to be connected with the Marconi company, and proposes to erect powerful plants at Pittsburgh, Louisville, Evansville, Huntington, Cairo and other cities, and to co-operate with the weather bureau in each city in disseminating weather and river information. The stations are expected to be ready for operation by fall.

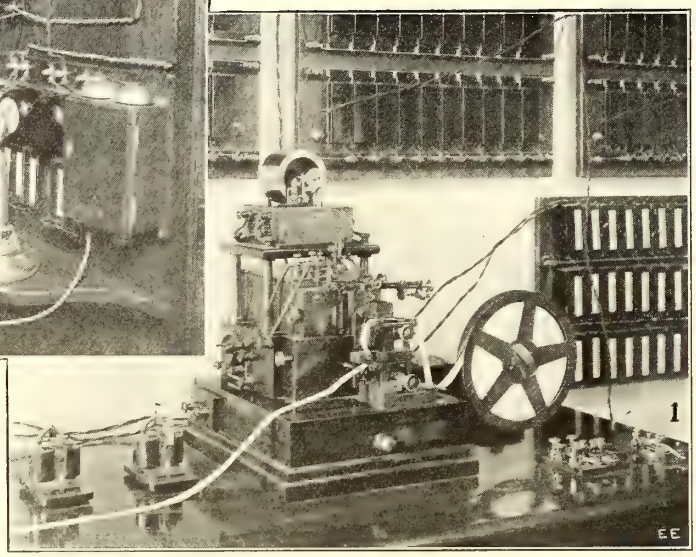
To analyze the unburned gases given off by industrial plants a French scientist has invented electrical apparatus which makes the tests and records the results automatically.

Long Distance Submarine Telegraphy and Telephony

HOW would you like to speak to your friend in Cairo, Paris or Liverpool from your office or home by simply removing the receiver, get central to connect you and then hear your friend's "Hello" over the wire? This may soon be a realization, as the inventions of Dr. Guiseppe Musso tend to prove.



Below (Fig. 1) Portrays Dr. Musso's Highly Perfected Long Distance Telegraphic Recorder, Which Prints the Dots and Dashes on a Moving Paper Strip.



Above (Fig. 2) Illustrates the Small Difference Between Dr. Musso's (at left) New Submarine Cable Telephone Set and Ordinary Telephone (at right).

Many telegraph and telephone engineers are only too well aware of the difficulties encountered in the submarine cables, such as enormous inherent capacities, resistances, etc. Some companies have even gone to the extent of developing a new cable with which to reduce the large amount of capacity, and thousands of dollars have been expended in this direction, but very little headway has been made. The longest talking distance ever covered with a submarine cable was 31 miles. Also the incoming speech waves were so indistinct that it was practically impossible to reproduce articulate conversation.

However, with this latest invention of the Italian scientist, the Government has recognized that greater distances can be covered and has tested the apparatus with an actual submarine cable in Alaska, which carried successfully speech over a distance of 320 nautical miles. Arrangements are now being made for greater experimentation along this line, and distances up to 3,000 miles have actually been covered with an artificial line, as partly illustrated in Fig. 1. This consists of lumped inductances and capacities mounted on the wall.

The various condensers on the wall represent the capacity of the usual cable. By changing the circuits various artificial cable lines can be obtained. Fig. 2 shows the difference between the present telephone (at the right) and Dr. Musso's long distance submarine cable telephones. No additional apparata is required, with the exception of those illustrated here.

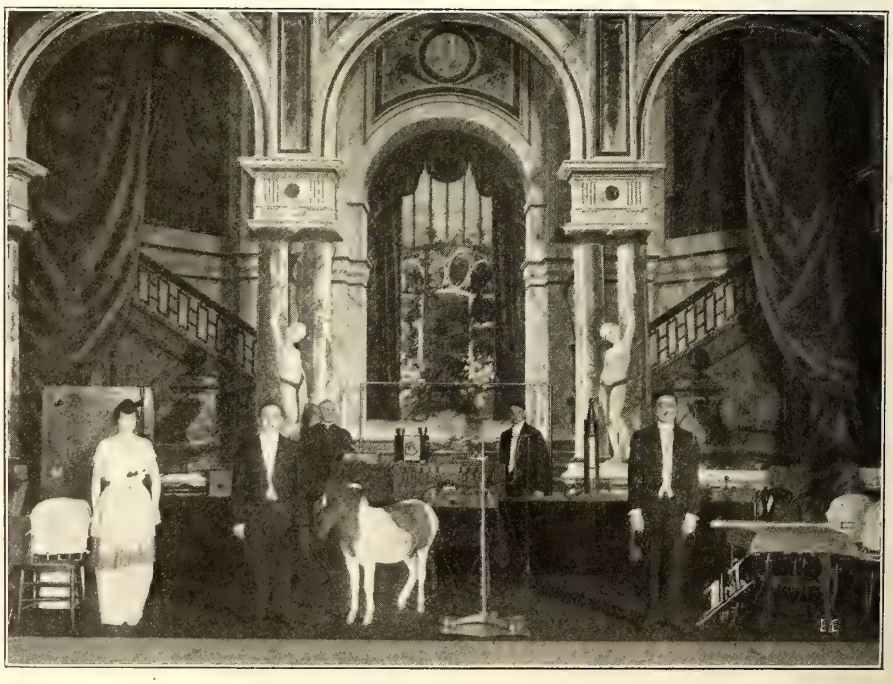
Dr. Musso has also turned his inventive brain to the development of a high speed submarine cable telegraph apparatus. The receiving apparatus of the recording type is shown at Fig. 2 on the table in the foreground. Messages can be recorded with much greater rapidity than that with which the human hand is capable of writing; the signals being automatically notated on a strip of paper, as perceived.

ELECTRIC PONY SHOOTS SPARKS

Many spectacular adaptations have been made for several years past of high frequency electric currents on the theatrical stage, with great success. But the ever active, quick-witted minds of theatrical performers have now discovered a new scheme for attracting and holding the interest of the public in the application of these high frequency currents to animals. At first it appeared as if this new idea would never be successfully produced, as in many cases the animal would become electrocuted by the current, or the shock would prove sufficient to make the animal uncontrollable.

However, after long, persistent practise and training Mr. La Reine has succeeded in applying these high voltage currents to a pony which is now able to withstand the shocks without any outward or visible sign of emotion.

The illustration herewith portrays Mr. La Reine and his pony performing a stage act known as "The Electric Pony." The animal is charged with high voltage electricity, produced by a Tesla coil, and various interesting electrical feats are enacted, such as drawing sparks, lighting paper from any part of its body, and many others. The act is intensely interesting to the audience and the effect very spectacular.



The Pony That Shoots Forth Electric Sparks for the Amusement of Theater Audiences.

BLIND WIRELESS OPERATOR.

J. William Ellis, of Lakewood, said to be the only blind wireless operator in the world, opened a wireless telegraph station at Rocky Point, R. I., recently for exhibition and transmitting purposes. The antennae extends from the Rocky Point tower to the cupola of the hotel, the station being in the tower.

All kinds of commercial and naval messages were received, including those from outgoing and incoming steamers all over the coast from Canada to Guantanamo Bay, Cuba. Visitors are invited to the station to watch Mr. Ellis operate.

Mr. Ellis has been engaged in the wireless operating business for 10 years, for the last eight years as builder and manufacturer of all kinds of receiving and sending wireless apparatus. He was a commercial operator eight years ago at the Waldorf-Astoria Hotel in New York, and has also operated for the New York Association for the Blind and the Metropolitan Opera House. He has also controlled and operated a large receiving station at Lakewood.

Wireless apparatus that weighs but eight pounds yet will transmit messages 21 miles and has received signals more than 300 miles has been invented by a New Jersey man.

Enameled Magnet Wire, Its Properties and Manufacture

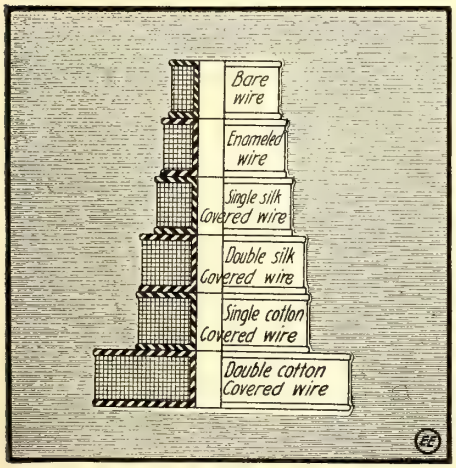
By L. Earl Deane

THE older readers of this article will probably remember that in Franklin's time electricity was not considered as it is now, nor did the Philadelphian have the modern conveniences with which to conduct his experiments. Annunciator wire was not used to conduct the current to the key, nor was a toy motor, such as a Knapp or Loomis, used to wind in the kite. One is caused to wonder, when he stops to think of the marvelous advance within so short a time, in every phase of electrical progress.

Electricity in the time of Franklin was considered an uncontrollable atmospheric discharge. Later it was found to have been wrongly considered and was called a fluid, because it apparently flowed, as did water, through certain mediums. Now we think that we have it boiled down to a vibratory motion of the molecules or etheric electrons.

Knowing that electricity traveled with varying degrees of strength and velocity through different mediums, it became necessary to "insulate" the conductors, to interpose some substance between the conductor and other conductors, so as to prevent "leaks." Such a substance was said to possess a "dielectric" quality. Silk and cotton, being found low in the scale of conductors, came into universal use. Coils were wound for individual use, no attention being given to another's problems.

It was known that certain laws existed concerning fixed relations between the number of turns on a coil, size of wire used, resistance of winding, current consumption and work to be performed. It was also known that these relations varied with the thickness of *insulation*. The problem then was to get at the basic principles, formulate them, and arrive at some standardized results which would prove of practical value. Engineers became interested. The old forms of insulation were unsatisfactory for several reasons: They occupied too much space; broke down under moderately high voltage; would not withstand high temperatures; absorbed moisture; and disintegrated under the action of acids.



Showing Relative Volume of Various Kinds of Insulated Magnet Wire. Note Small Space Occupied by the Enameled Wire.

Thus you see the great problem which the inventors and experimenters in industrial chemistry had to attack. A covering was to be found which would occupy less space than does a single silk thread. High tension currents must be carried safely. It must withstand heat, both external and internal. It must be impervious to moisture and inert to chemical action. It is not necessary, if I could indeed do so, to relate all the difficulties encountered. Suffice it to say, the first producers of enamel wire placed on the market a form of insulation —an enamel—which met all these requirements and was also elastic enough to be practicable.

As to the voltage test on such enameled wire, I will give the result of a recent experiment performed by Prof. A. B. Smith, of Purdue University. A three-foot length of No. 36 B. & S. wire stood the following voltage tests before puncturing:

Enamel, 736 volts; single cotton covered, 587 volts; single silk covered, 527 volts. Thus you see the advantage of enamel over fabric covers as to danger of electrical breakdowns.

As to the space occupied the following tables show the great saving in enamel over the older insulations, as to number of feet per pound and outside diameters of various covers.

WIRE, APPROXIMATE FT. PER LB.

B. & S. gauge.	Single cotton.	Single silk.	Enamel.	Bare wire
24	763	799	810	818
27	1,500	1,584	1,620	1,639
30	2,860	3,148	3,240	3,287
32	4,234	4,913	5,132	5,227
35	7,755	9,536	10,197	10,480
40	18,376	26,558	32,107	33,410

OUTSIDE DIAMETERS.

B. & S. gauge.	Single cotton.	Single silk.	Enamel.	Bare wire
14	.0686	.0661	.0660	.0641
20	.0365	.0340	.0333	.0320
27	.0182	.0162	.0152	.0142
35	.0096	.0076	.0061	.0056
40	.0071	.0051	.0034	.0031

The above tables show enameled wire to be in close proximity to bare wire. The importance of this is best shown by the law of comparative activity: *The activity of a coil winding varies directly as the ratio between the cross sectional area of the conductor and that of the conductor plus the insulation.* To make it plain, the closer the winding lies to the core the greater the strength of the magnetic field, and enameled wire brings the turns closer to the core because the insulation is thinner.

Enamel is guaranteed to withstand a temperature of 500° F. provided the coil is allowed to cool before being moved. I have seen cases where the test was much more severe than this, but a conservative guarantee is 500°.

Internal heat, whether by normal or abnormal currents, is diffused by enamel, so that the proper working temperature of the coil is more easily obtained and maintained.

Enamel is not affected by moisture, water, oils or greases, nor is it injured by chemical action. Gases and fumes, so often encountered, do not injure enamel.

Mechanical strength, twists, turns, etc., may best be proved by actual test. Enamel will stand far more abuse than will fabric covers. It may be stretched without opening the insulation, as will fabric.

The combination covers, cotton or silk wound over enamel, afford the same advantages as enamel, with the additional protection for voltage or to serve as a cushion in cases where it is necessary because of mechanical difficulties, friction, abrasion, jarring, etc.



Fig. 1 (at left) Shows Machinery Used in the Manufacture of Enameled Magnet Wire. Fig. 2 (above) Illustrates Part of the Finishing, Winding and Inspecting Department.

With the fact that less wire in weight, in enamel stock, is required than in fabric covers; that it costs less by the pound than any fabric; and that there are more feet to the pound than in the fabrics, the greater saving is evident.

The process of manufacture is depicted partly by Fig. 1. This shows the process as used by the American Enameled Wire Co. The bare wire runs from the spools, S (there is a table, T, on each side of the oven, so that twenty wires run through each machine, ten on a side), over the pulleys, P, through the enamel tank, E, which is heated by an electric heater. From there it runs vertically through the oven, O, where it is baked at the proper temperature. Gears, F, drive fans to keep the temperature even throughout the oven. Each machine is also connected to a blower pipe, which serves as an additional equalizer of oven temperature. This process is repeated five times, five coats on a wire, even down to No. 40, which measures .0034 inch outside diameter. Each coat is baked hard separately before the next coat is applied. The finished wire runs off on to spools at W.

From the enameling room the wire goes to the inspection room, Fig. 2. Here every inch of wire is inspected by experts before it leaves the plant. Any defective spots are cut out and the wire is welded and enameled at the weld, leaving no joint or large place. The weld is not weakened and cannot be detected from any part of the wire.

Despite the most careful precaution in enameling some defective wire gets through to the inspectors. The power plant is governed so as to keep a uniform speed on the machines. Machine shafts are con-

trolled for the same purpose. All working rooms are kept at a constant temperature. The machines are "boosted," so that even the very fine sizes of wires are not stretched in running through as many times as they do. Pin holes, burnt or raw enamel, rough spots, lack of uniformity in size, etc., must be noted and detected by the inspectors. Wire must measure to size or it is rejected. The finest possible instruments are used for this, measuring directly to .0001 inch.

From inspection it is sent to the main shipping room, where it is boxed and sent to all parts of the world.

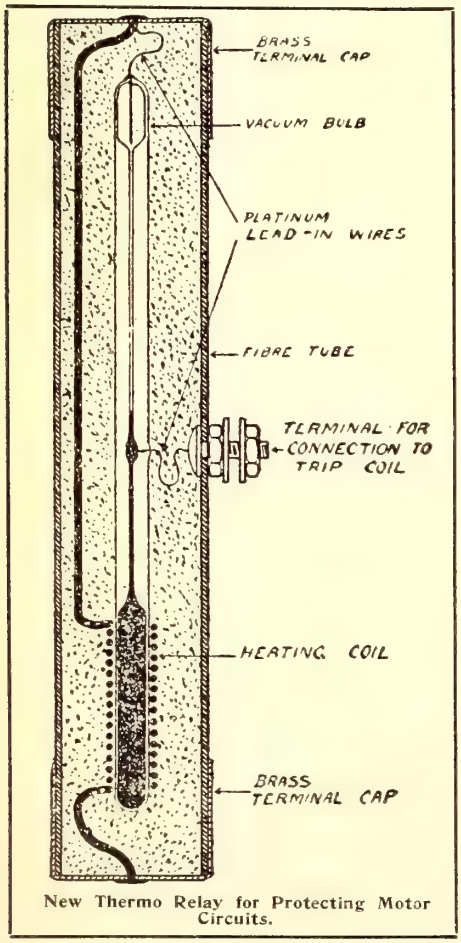
Just another point before quitting the issue—do not hesitate to ask the manufacturers for information. Some one often asks me how to clean the wire for terminals, etc. The maker of the wire which you use can give you a tip on this that will be worth asking for. Suggestions as to binders, etc., are sometimes desirable. Do not be afraid to ask what you want to know. In all probability the engineers of the wire company can help you, and if not they will be willing to tell you so and no harm will be done by communicating with them.

(Copyright, 1914, by L. E. Deane.)

NEW THERMO-RELAY FOR MOTOR PROTECTION.

A very ingenious and undoubtedly efficient electric motor protector, similar in size to the usual cartridge fuse, with which we are all familiar more or less, is shown in the sectional view here depicted.

The principle of this device, known as the "Thermo-Relay," is based upon the fact that if a small coil of wire, forming a heating coil as our illustration shows, is placed around the base of a glass tube, similar to a thermometer tube and which contains some mercury, then when a certain current passes through the circuit (and consequently through the heating coil which is in series with the main motor leads) the mercury will gradually rise. Now when a certain predetermined amount of amperes passes through this device, the mercury will rise high enough in the tube to close a trip coil circuit through the binding post in the side of the tube, as indicated.



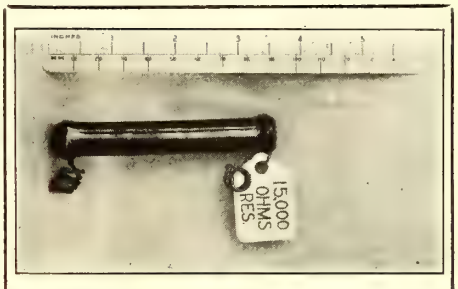
New Thermo Relay for Protecting Motor Circuits.

The trip coil acts the same as a circuit breaker coil, of course, and opens the switch, thereby cutting off the current supply to the motor. This device evidently is extremely practical and sturdy in its operation, as the manufacturers of the same offer $100 to anyone who can burn out a motor properly protected by the use of these Thermo-Relays in the main circuit.

NEW COMPACT RESISTANCE UNIT.

Herewith is a photograph which shows a new and extremely compact resistance unit 7/16 inch in diameter by 3½ inches long.

This resistance unit has 15,000 ohms of resistance on one layer of wire. The wire is so fine that it would be crumpled up in two or three days if left open to the atmosphere with no current passing through it, but it is covered with a vitreous enamel insulation which protects it from the oxidizing influence of the atmosphere, causing it to last an unlimited length of time.



Smallest "High Value" Resistance Made.

This tube is interesting. It is a porcelain tube with wire wound upon it and covered with a vitreous enamel which entirely encloses it and protects it from chemical, mechanical and electrical deterioration. It is doubtful if a unit of half this resistance, or even a third of this resistance, has ever been produced, in this space, on a single layer of wire, up to a short time ago.

POWERFUL NEW CHINESE RADIO PLANT.

Arrangements have been completed for the erection of a wireless installation at Foochow at a cost of $15,000. The plant is to be of the Telefunken style, with an A. E. G. (German) dynamo of 12 kilowatts, converter and a gas engine of 28 horsepower. The storage batteries will be charged from the dynamo; the converter, being operated by the storage batteries, will make an oscillating current of 500 cycles. Two wooden masts are to be erected, each 200 feet high. The guaranteed range is 1,500 miles at night and 650 miles in the daytime, although it will be possible to secure a range of 2,000 miles and 1,000 miles, respectively.

The wireless station will be operated in connection with and under the control of the Chinese Government telegraphs and will be devoted chiefly to military use. Public messages will, however, be sent and received to and from ships and the wireless stations already erected at Shanghai, Canton and Wuchang. Wireless plants have now been erected or are in process of construction at Shanghai, Canton, Peking, Kalgan, Wuchang and Foochow. Four more stations are to be installed, two of which will probably be at Yunnanfu and Chengtu.

ELECTRIC ILLUSION SIGN FOR BARBERS.

A very attractive electric illusion sign was recently perfected and put in operation for a New York barber. The sign herewith illustrated consists of a circular disc of glass and having three colors; red, white and blue painted on it, as shown.



Novel Electric Illusion Barber Sign.

This disc is rotated at medium speed by a small electric motor connected to the shaft of the disc by means of a leather belt. When in operation various novel effects are produced by the constantly changing colors, which never fail to attract the eye of the passer-by. This sign is one of the well-known Federal line.

IONOMAGNETIC ROTATION.

A. Righi finds that a body turning lightly on an axis and placed inside a gas suitably diluted and ionized (for instance, by means of sparks) will commence to rotate around its axis as soon as a magnetic field is created in the direction of the axis. This phenomenon the author has called ionomagnetic rotation. He explains it as follows: It is known that the path of an electrically charged particle (ion or electron) changes when a magnetic field commences to act, and when this field is uniform the path becomes a helix with its axis parallel to the field. The sense in which this curve is followed is identical with the sense of the current flowing in the coil producing the field when there are negative ions or electrons; the sense is the opposite when there are positive ions. So when there exists a magnetic field the ions and the electrons will follow helical areas instead of straight paths.

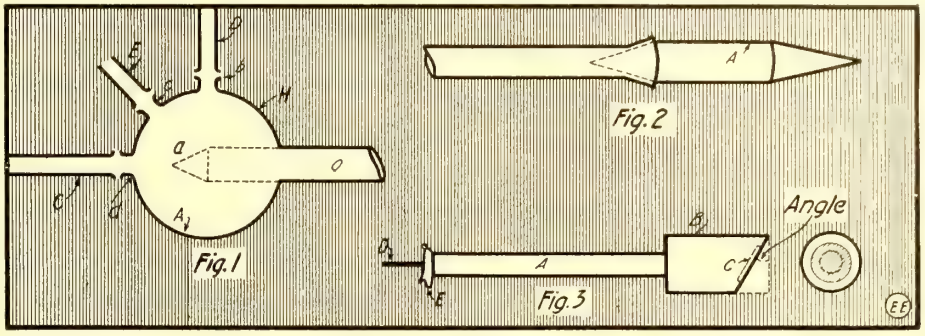
Owing to the action of the magnetic field they will be directed all in the same sense and all around the body, thus producing the rotation of the latter. This will occur in the same sense as the current producing the field in the case of positive ions, and in the contrary sense in the case of negative ions. As the couple changes sign with change in sign of the electric particles, the ionomagnetic rotations will be generally produced by the difference of two couples of contrary signs. At the beginning of these researches the author was for long in doubt whether the rotations observed could be explained by the actions of the ordinary electromagnetic forces. Finally he has been led to conceive that the well-known forces which provoke the movement of a conductor through which an electric current is passing, when other currents or a magnetic field are acting, are the result of the shocks of the electrons which, according to modern theories, move in the interior of the conductor and constitutes the current.—Abstract from *Atti Asso. Elet-Italiana* in *The Electrician*, London.

X-Ray Tubes and Their Manufacture

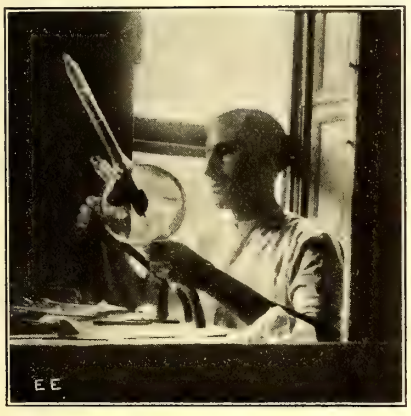
By Samuel Cohen

IT was not until after the discovery of the phenomena of the X-rays by Wilhelm Konrad Röntgen that the world realized the value of these powerful penetrative rays. Many articles have been written on the theory of X-ray tubes, but none of these tell how the tubes are made. It is the intention of this short article to show the reader how these tubes are manufactured.

One of the first operations consists of blowing out the bulb A, Fig. 1. This is done by closing a glass tube O at point (a) and heating it to redness. When the operator sees that the glass is heated to the right temperature he then slowly and carefully blows into the open end of the tube, which expands the hot soft portion of the tube at (a), and by blowing constantly and turning the tube in the flame the bulb A is formed. After the bulb is blown to the proper size the holes b, c, d are next made. This is done by heating the glass at the indicated points with a sharp blow flame and then blowing into the neck, which forces the soft heated parts out. A small projection is made on the holes as shown; the purpose of these projections will be seen later. All the blowing of the glass is done by the operator, and no compressed air is utilized.



Various Stages in Manufacture of X-Ray Tubes.



Expert Glass Blowers Are Employed Only in Making the X-Ray Tubes.

The electrode glass tubes are next made. They consist of a glass tube of proper dimensions, and on one end of these tubes a small flared portion is made. This is done by heating one end in a flame and introducing a conical piece of charcoal, as shown in A, Fig. 2. The projection of the hole in the glass bulb and the flared end of the electrode glass tubes (c, Fig. 1) are now welded together; they are heated simultaneously in a brush flame, that is, a pointed flame, and jointed while quite soft. The joint is made true and even by constantly turning the tube to keep the glass evenly heated. All the electrode tubes are welded in the same manner.

One of the electrodes consists of a tungsten alloy disc C, Fig. 3, welded in a solid copper rod B. A cylindrical iron tube A is used for supporting the target C and copper rod B. Extreme care is taken in making the proper angle on the copper rod as shown. The deflection of the X-rays depend wholly upon this angle of the tungsten target. A short piece of platinum wire D is next welded to the iron cylinder A. A small quantity of soft glass E is now poured on the end of the cylinder. The electrodes G and F (Fig. 4) are made in the same way, but consist only of aluminum discs instead of the tungsten.

The next process is to weld the electrodes to the tubes C, D, E, Fig. 1. The electrode is placed inside of the tube, and the end of the glass tube is heated to redness. It is now closed and a small hole is made by forcing a piece of glass through the soft portion. The platinum wire is now passed through this hole and the end is again heated. The glass on the end of the electrode E, Fig. 3, welds together with the end of the glass tube and it is thus sealed up. The weld is made smooth and true by constantly turning the end in a flame and blowing through end H (Fig. 4) until the end is perfectly sealed. The other electrodes are sealed in the same way.

The tube is now ready to be exhausted. This is accomplished by connecting the small open tube H, Fig. 4, to an exhaust or vacuum pump, which may be a mercury, oil or molecular exhaust pump. After proper vacuum is obtained the glass tube H is sealed, while the pump is exhausting the tube. This is done in order to prevent any air entering the bulb. Names and trade-marks on these tubes are made by the etching or sand blast process. The location where the name is to be etched is inserted in a solution of boiled common wax and allowed to dry. The name is next marked out in the wax and then dipped into hydrofluoric acid, which dissolves glass. The etching continues for a few minutes and then the tube is rinsed in clear water. The wax is now removed, allowing the neatly etched letters to remain.

The main difficulty in the manufacture of X-ray tubes is in the glass work, and therefore expert glass blowers are required. The day will come, perhaps, when someone will invent a machine for blowing glass bulbs automatically, which will reduce enormously the price of X-ray tubes.

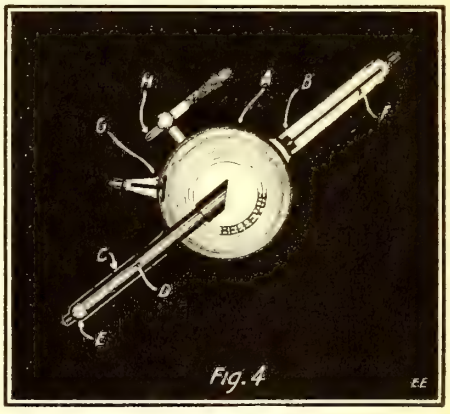


Fig. 4. Showing the Different Parts of X-Ray Tube Assembled.

At present all the work in making X-ray tubes may be said to be hand work and thus the expense is severely high.

A BATTERY TYPE MAGNETIZER.

By Frank C. Perkins.

The accompanying illustration shows an effective battery type magnetizer of the Swedish-American type developed at Chicago, Ill. It is pointed out that magnets should always be kept fully charged. All magnets lose their strength in time, and this results in decreased efficiency of whatever device they are used on. This holds true of telephone apparatus, automobile, motorcycle and motor boat magnetos, charging and lighting generators.

In telephone apparatus weak generators, receivers or ringer magnets will render satisfactory service impossible, and in magnetos for gas or gasoline engines a fully charged magneto with "saturated" magnets gives a much fatter, hotter spark than one whose efficiency is lowered by weak magnets.



New Portable Type Magnetizer for Recharging Magnets.

It is recognized that sending of the magnets to the manufacturer to be remagnetized causes long delays and considerable expense, and they are often demagnetized or broken in transportation. These difficulties can be eliminated by using a magnetizer of the type illustrated in the accompanying photograph, which is efficient, durable, compact, sturdy and easy to operate. It requires no experience to "charge" magnets, and it will operate on five ordinary dry cells or a 6-volt storage battery or on 110-volt direct-current lighting circuit.

It is quickly adjustable to any size or shape of magnet. It is equipped with a switch which automatically cuts off the current. Less than half a minute is required to fully energize or "remagnetize" any magnet. Thus this device saves both time and money.

The Static Machine, Past and Present

THE large static machines, or for that matter even the smaller ones in use to-day, are quite efficient indeed and a wonderful improvement over the first attempts made in producing static electricity.

The earliest form of electrical generating machine of the static type was that devised by Otto Von Guericke, of Magdeburg, Germany, in the year 1630. His machine consisted of a globe of sulphur fixed upon a rotatable spindle, so that it could be turned around rapidly by means of a crank, and static shocks were obtained from this crude device by pressing against the surface of the sulphur ball with the hand while it was being turned.

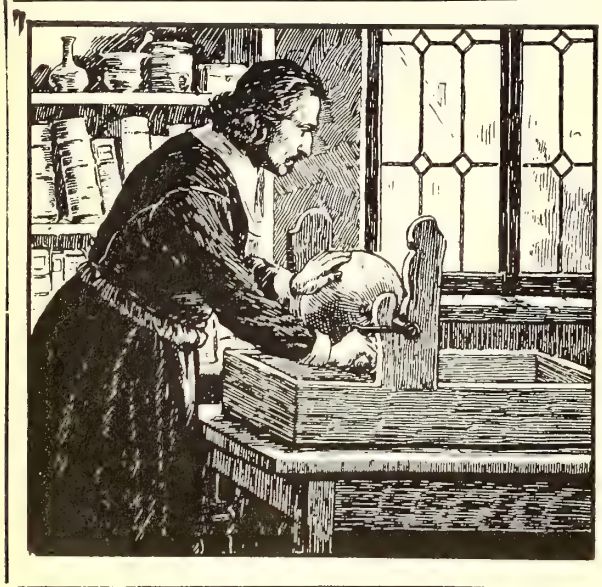
With this simple arrangement Von Guericke discovered the existence of small electric sparks and the peculiarity of static electric charges. This sulphur ball machine and Von Guericke himself are seen in illustration at Fig. 1, while Fig. 2 shows some of the experiments being made with this crude static generator. The boy hanging over presses against the sulphur ball with his feet and transfers the static electricity to the young lady by means of his hands as depicted. Note the electric attraction of the small bits of paper from the table on the extreme left.

Later Sir Isaac Newton, of England, replaced the sulphur ball utilized in Von Guericke's machine by a globe of glass. At a later period the general form of the machine was improved from time to time by several German electricians, notably Von Bose, who added a collector or "prime conductor" in the shape of an iron tube, held by a person standing on cakes of rosin to insulate him from the ground, or else the collector was suspended by silken threads. Also Winckler, of Leipzig, substituted a leather cushion for the hand as a rubber, and Gordon, of Erfurth, rendered the static machine more easy of construction by making use of a glass cylinder instead of a glass globe. The electricity in this case was led from the excited cylinder or globe to the prime conductor by a metallic chain, which hung over the globe. A pointed collector was not employed until after Franklin's famous researches on the action of points with respect to electric charges.

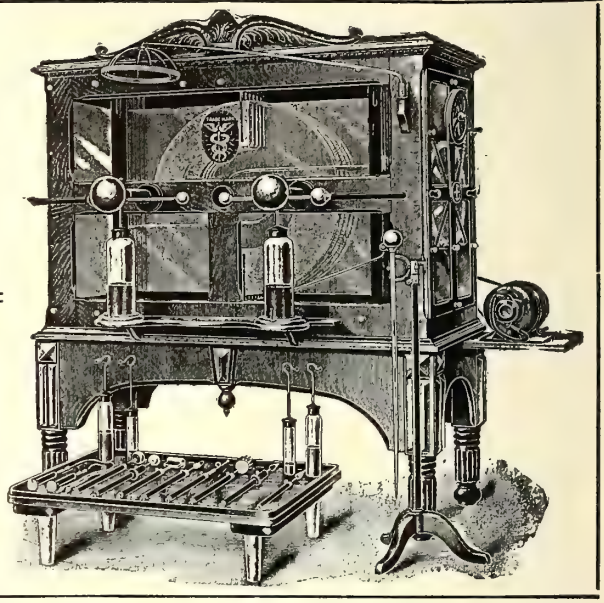
About the year 1760 De La Fond, Planta, Ramsden and Cuthbertson developed machines using flat glass plates instead of glass cylinders. Fig. 3 shows a static machine built by Martinus van Marum, in 1785, utilizing the glass plate principle. The machine consisted of two glass plates 23 inches in diameter and 7½ inches apart. The sectors were 15½ inches in diameter and were made of sheet copper. The glass standards were 57 inches high. When this generator was in operation it only developed a thin spark 8 inches long and a brush discharge in the dark of 21 inches. The two plates were operated by means of a large crank shown at the extreme left and designed for two men.

From that time on the principal modifications and improvements in the static machine have been along the line of the substitution of ebonite or hard rubber, and in some cases patented compound mixtures instead of glass for the rotating plates have been employed. Further improvements have been made in the invention of compound machines, depending upon the principles of induction and convection.

A modern type of static machine capable of giving steady and powerful sparks 20



At Left, Fig. 1, Is Seen Otto Von Guericke, the Earliest Worker in the Field of Static Electrical Machines and Also His First Crude "Sulphur Ball" Static Generator Made in the Year 1630.



At Right, Fig. 4, Illustrating the Latest Model Multiple Glass Plate Static Machine, with Driving Motor. It Will Develop Heavy Sparks 20 Inches Long of Great Electrotherapeutical Value.

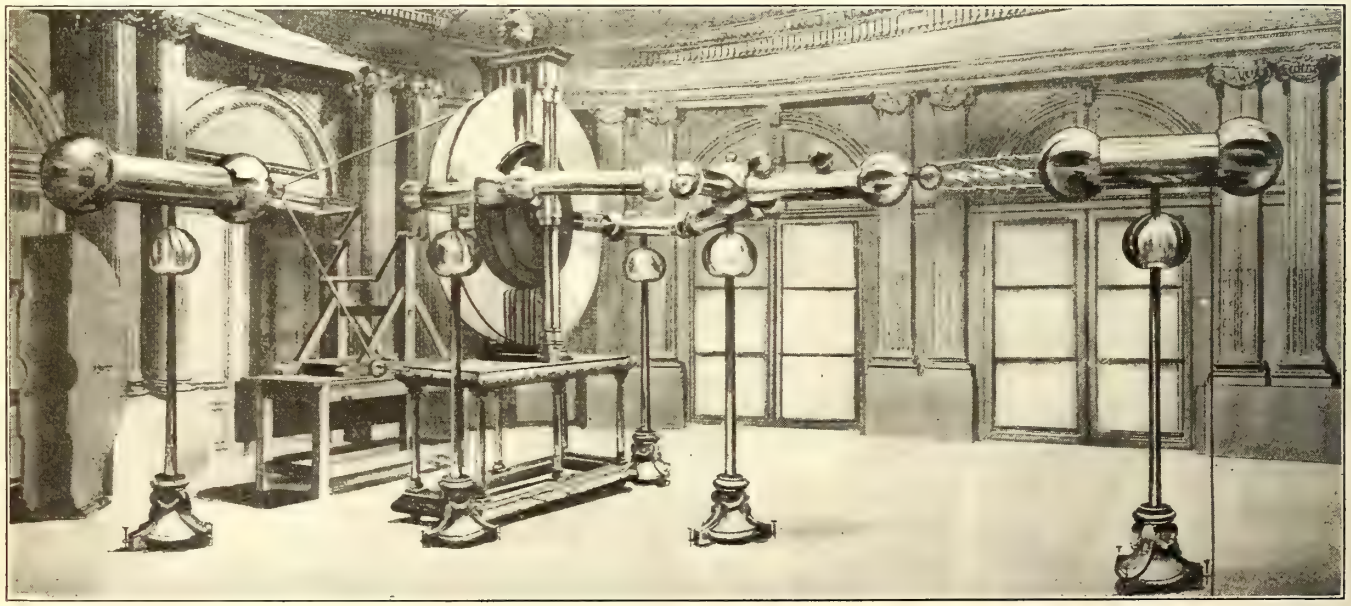


Fig. 3. This Portrays an Early Static Machine of Massive Proportions, Built in 1785 by Martinus Van Marum. This Ponderous Machine Standing 10 Feet High, Produced But 8-inch Sparks.

inches long is shown in Fig. 4. This machine has a multiplicity of large rotating plates, and also makes use of Leyden jar condensers to increase the activity or volume of the discharge between the smaller brass balls observed on the side of the machine. This powerful instrument is driven by an electric motor and is much used for physicians' requirements. A complete set of various electrodes for treatment work is shown on the insulated glass foot stand. The static machine is of low over-all efficiency and is being rapidly substituted by modern high-voltage transformers and spark coils.

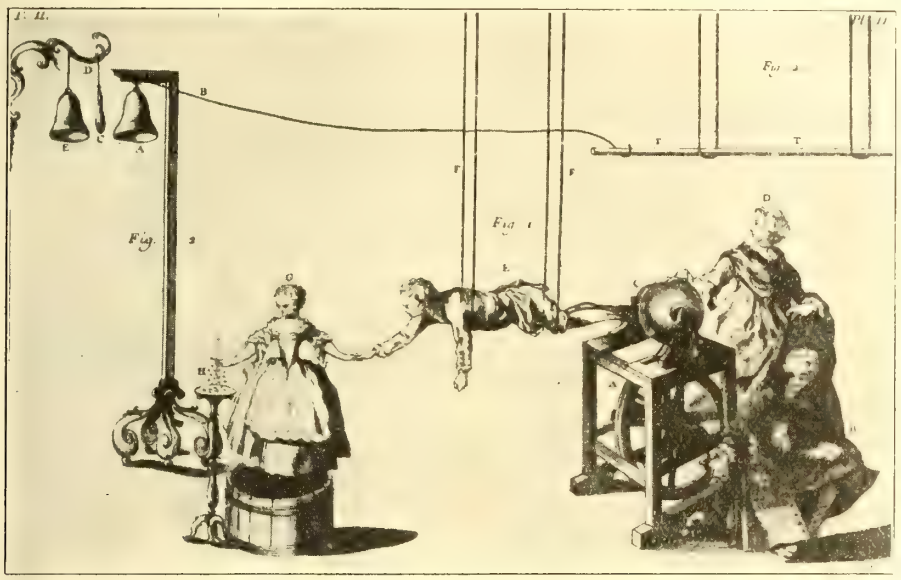


Fig. 2. Experiments with the Early Static Electric Generators Were Mostly Carried Out With a "Human" Prime Conductor as Here Shown.

OZONIZER HELPS FISH CANNERIES OF EUROPE.

New uses for electricity are being discovered every day. Even in war-swept Europe ways and means are being devised whereby electricity is employed to lighten labor and to improve working and living conditions. One of the latest and most novel applications is the use of Westinghouse electric ozonizers to reduce the odors usually prevalent in the fish canneries of Norway and Sweden, which, as is well known, supply a large part of the world's needs and form one of the chief industries of those countries.

Several months ago 50 of these devices were installed in the canning factories that line the coasts of Norway and Sweden, and their success was so marked that orders were immediately placed for approximately 130 additional ones, which will soon be in operation.

An ozonizer is a device that converts part of the oxygen in the air into ozone, which is nothing more than a modification of oxygen, having increased chemical activity. It has properties similar to those of oxygen, but to a more marked degree. It is a strong oxydizing agent, and, therefore, attacks organic material, such as germs, bacteria and the small organic particles that produce odors. It is this property of being able to destroy odors that has made the ozonizer so popular in the canning factories, and it is claimed that, while its use does not entirely eliminate the strong odors attending this work, it reduces them so they are not objectionable. By doing this it greatly improves working conditions, making them more pleasant and more sanitary.

Ozone is produced naturally by lightning discharges, by the slight electric effect produced by the separation of particles of spray from waves and waterfalls, and by some other of nature's processes. The manner in which it is produced electrically is interesting. A current at high voltage is applied to the inside and outside coatings of specially prepared glass cylinders and minute brush discharges take place over the inner surface. These tiny discharges act on the air in the cylinder or tube and change part of the oxygen in the air into ozone.

WHEN EDISON GOT MARRIED.

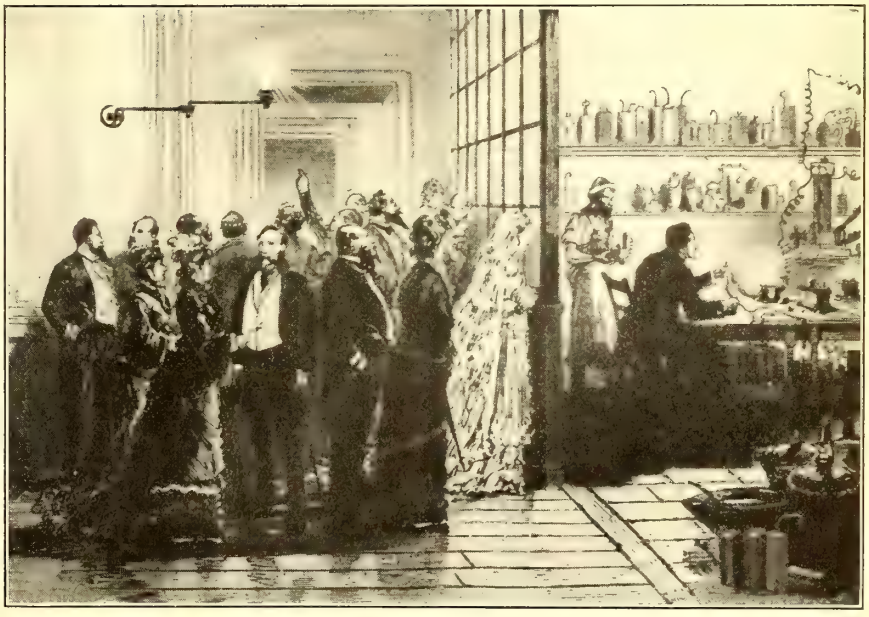
Although it is a fact not generally known, Thomas A. Edison, the master inventor, was so engrossed in his electrical researches at the time of his marriage in 1873 to Miss Mary Stillwell, that at the appointed hour when the minister was to pronounce the ceremony, the guests were unable to find Mr. Edison for some time.

Finally he was located in his private laboratory, experimenting with the electric light, which was in those days, of course, a great novelty, and, in fact, a brand new branch of science.

Our illustration herewith reproduced from an old print shows this episode in Edison's life and follows in many ways a number of other incidents which have occurred during his strenuous career.

It is recorded that at one time he had presented to him a box of "Havana" cigars, and although they were of doubtful quality he in a very short time had smoked the whole box of them. Absent mindedness such as this is an attribute of the greatest scientists of the world. When walking about his extensive laboratories at West Orange, N. J., it is rarely that Mr. Edison notices anyone, whether they are callers or not, and he walks by even when close enough to brush their clothes with his coat. He does not recognize them even though they are old-time friends, as he is so intensely absorbed in thought over some invention or other.

Mr. Edison's wife has undoubtedly helped in a myriad of ways to make him the master inventor and scientist that he is to-day.



How Edison Was Married.

THIS MODEST INVENTOR WOULD STOP WORLD WAR.

"I can make the United States the strongest nation in the world. I can end the European struggle in a short time. I can make the smallest nation most powerful."

This is the assertion of John Vogelzangs, of Menominee, Mich., an inventor, who claims to have a method of extracting electricity from the air so that aircraft might be manned with powerful guns and not be forced to land until they want to.

"I can sweep the seas clear of vessels. I can kill armies and level cities," claimed the inventor, who in the same breath asserted he favored universal peace, but that the world was not ready for it.

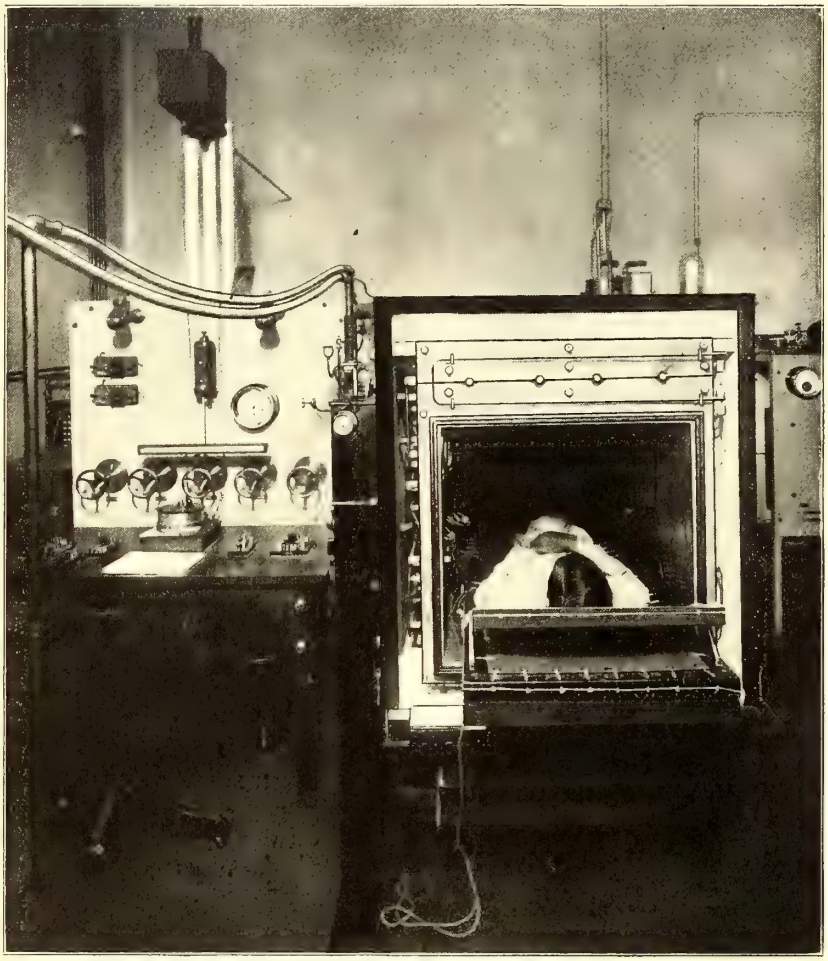
He says Secretary Daniels' plan for an advisory board is good. He refused to give out much information about his new device, and said he lacked money to carry on the work and displayed a letter from Mr. Daniels, written before the war broke out, saying this nation was not ready to take up his ideas.

Vogelzangs has a reputation for being an inventor of ability. He made a street cleaner which he refused to sell for $10,000.

New Calorimeter Registers Energy of Man's Every Move

A respiration calorimeter is an apparatus designed for the measurement of the gaseous exchange between a living organism and the atmosphere which surrounds it, and the simultaneous measurement of the quantity of heat produced by that organism.

The first contrivance of this nature was described by Lavoisier in 1780. It will be remembered that Lavoisier was the first to comprehend the significance of the then newly discovered oxygen. Primitive though the apparatus was, yet intellectually inspiring was the mind which so early grasped the principles and understood many of the difficulties.



Marvelous New "Human" Calorimeter Which Is So Sensitive in Its Adjustments That the Heat Generated by the Mere Raising of a Man's Arm Indicates on an Instrument.

In our illustration the large opening at the head of the box, into which a man can be slid, measuring 76x70 cm., is closed by two glass plates 7.5 mm. thick, each of them sealed after the subject has entered the calorimeter by means of a mixture of five parts of beeswax and one and a half parts of Venice turpentine. There are numerous pipes and electric cables entering the box for the various control devices, thermopiles, etc.

On the surface of the outer copper wall are attached the wires connecting up the thermopiles. The pipes for cold water are swung on brass angles attached to this surface, and the enameled "Therlo" resistance wire is bound on insulators to the same surface.

It is remarkable how promptly the spirometer (air-pressure gauge) rises when the person within the box makes even a *slight movement* of a hand or leg. In fact, it makes so delicate a movement record that a Porter *work-adder* has been attached in such a manner that the downward movement of a counterpoise weight winds up a thread, and the total amount of thread so wound represents the total work done by the patient during that particular period. By standardizing various movements of the body such as turning over or lifting the arm, it is possible to gain a fairly accurate idea of the amount of muscular movement and express it in centimeters of thread, thus obviating the necessity of printing long, graphic records. So sensitive is this machine that an ordinary telephone is not adaptable for use inside the chamber if a man has to make any movements at all, so a dictagraph with super-sensitive microphone is utilized to convey the subject's speech outside.

The thermopiles between the outer and inner copper walls of the chamber are arranged in three groups, 32 on the top, 30 on the sides and 12 on the bottom, the area covered by each group being warmed by a strand of enameled "Therlo wire," No. 24 B. & S. gauge, whose temperature is controlled by one of the adjustable rheostats.

One thermopile is arranged with one end in the outgoing air current and the other in the ingoing air. The temperature of the latter is adjusted to that of the former by means of a step rheostat and two 55-volt lamps. A similar rheostat controls the temperature of the ingoing water by means of a water-heating resistance.

By carefully controlling the rate of flow and the temperature of the water in the heat absorber it is possible to adapt this calorimeter to wide variations in the heat production of the subjects. For example, on April 23, 1914, an experiment was made on a cretin, with an average heat production of 26 calories an hour. The next day the subject was a patient with exophthalmic goiter, whose heat production averaged 107 calories. In one case the methods of direct and indirect calorimetry agreed within 0.2 per cent. and in the other within 0.7 per cent.

BOOK REVIEW.

"Practical Applied Mathematics," by Jos. W. L. Hale, S.B., E.E. Cloth covers, 206 pages, 185 illustrations. 5x7 inches. Price $1. McGraw-Hill Book Co., New York, N. Y.

A useful handbook on applied shop mathematics starting with the rudiments of arithmetic and leading up to the mensuration of solid and plane surfaces, cube root, practical use of graphic curves, simple binomial equations in algebra, etc. The treatment of each subject is unusually clear, showing in a very practical manner the relation betweeen mathematics and everyday problems, such as locomotive and car weights, strains, etc., tank and other volume calculations, micrometer readings, measurement and relations of angles, circles and spheres. An appendix of very useful tables is added to the book. This book may be recommended to anyone desiring to read up on practical applied mathematics and their adaptation to everyday shop problems.

Radio Stations of the World, compiled by A. Coleman and J. B. Harrietts. 200 pages. 5½x3 inches. Cloth covers. Vest pocket edition, 60 cents. Published by Radio Stations of the World, New York City.

This new radio call book contains in alphabetical order all of the official call signals which are arranged in such form that upon hearing a stations letters one can instantly find the name, nationality, etc., of the station to which that call has been assigned. The names of ship and shore stations are also arranged alphabetically in another section, which also gives the call letters. It also contains the international abbreviations (Q signals). It includes every merchant, government and naval vessel, the high and low power, commercial, government and private land stations of the entire world, both of countries which have and have not agreed to the radio-telegraphic conventions.

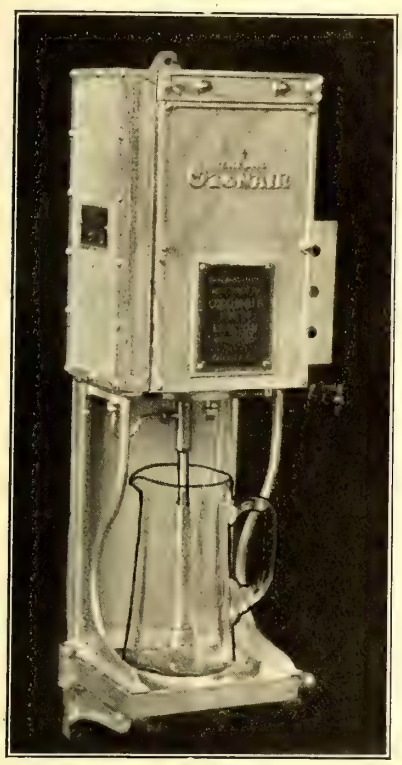
It is very handy and is claimed to be the only complete list of international radio stations and calls that has ever been placed upon the market. The book is printed in special clear type, on good quality paper, neatly bound in black cloth, stamped in gold, and fits the vest pocket. It should find a ready sale among all radio operators, both amateur and professional. Supplements are furnished to keep the work up to date. Also blank call pages are inserted to allow of filling in newly assigned calls in their proper relation.

SURGEONS USE ELECTRIC SAW.

Sawing bones by electricity instead of by the old hand method is now all the rage in surgery. It saves labor and makes for accuracy, and soon the suffering public, hearing of the latest, up-to-the-minute methods, will demand that when it must have its skull trepanned or the vertebral tibia sawed off, the job be done according to the latest styles in science.

NEW ENGLISH WATER OZONIZER

One of the most important details relating to the well-being and health of any community must be a pure water supply; pure not only as regards innocuous suspended matter, but free from the germs of such dangerous disease as cholera, typhoid, dysentery, etc. These scourges more often than not are caused by the contamination, accidental or otherwise, of the supply of water at its source or during its passage to the place of distribution.



Improved English Ozone Water Purifier.

Fortunately, there are several methods at hand by means of which these defects can be easily and cheaply remedied.

The simplest and most certain in its action is sterilization by ozone. Ozone is the ideal agent for water purification. It accomplishes its purpose without in any way altering the natural constitution of the water and at the same time leaves no trace of its presence. Water which previously was alive with dangerous organisms will, after proper subjection to ozone treatment, be in perfect condition for consumption. Moreover, its appearance and odor will have been improved, and it will have a sparkling brightness which, before the treatment, was absent.

A neat and efficient type of domestic Ozonair (British) sterilizer of this type, and using 45 watts of current, is here depicted. It has a capacity of 30 litres of water purified per hour.

Edison Heads New U. S. Navy Science Board

At last the American naval authorities, in the personage of Secretary Daniels, have awakened to the fact that battles of today, unlike those of yesterday, are really fought by scientists, either directly or indirectly. More and more it becomes apparent to even the layman that science, properly directed, can effect wonderful results when it comes to naval and particularly *land* battles on the scale upon which they are waged in this era.

Particularly is this noticeable in the reports from Europe, which state that the Germans are now using several kinds of highly poisonous gas guns, as well as gas bombs. But not only in the mechanical, but particularly in the electrical and wireless branches of science, are there most wonderful opportunities awaiting development.

To further the scientific development of military arms and devices in America, Secretary of the Navy Daniels recently sent out invitations to a number of the leading inventors and scientific men of the country. Thomas A. Edison, the peer of all inventors, has been selected to head the board of nationally famous inventors, which will include such men as Henry Ford, Simon Lake, John Hays Hammond, Jr., Orville Wright, etc.

The photograph herewith shows Mr. Edison and Secretary Daniels upon the latter's recent visit to Mr. Edison's home at West Orange, N. J., when plans were discussed.

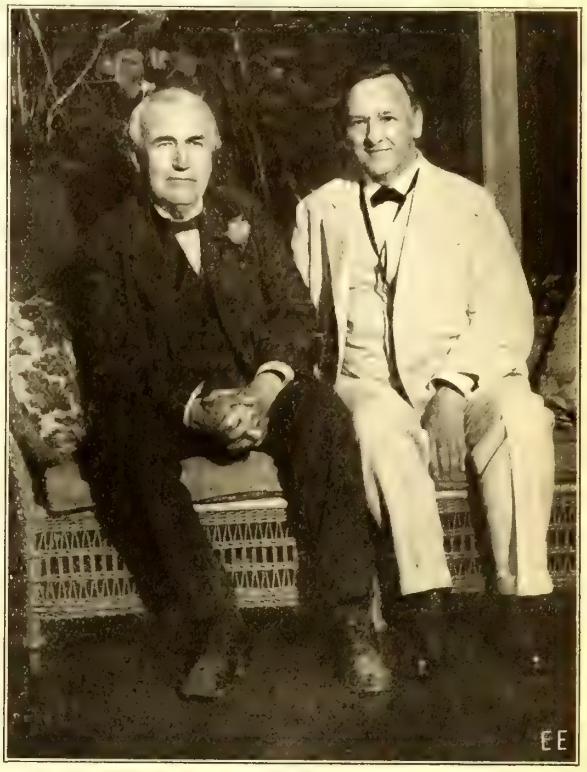


Photo (C) by International News Service.

Thomas A. Edison and Secretary of the Navy Daniels at Their Recent Discussion on the New Navy Science Board.

THE WIRELESS TORPEDO IN THE "MOVIES."

The wireless torpedo, which has been heralded far and wide as the greatest engine of destruction ever invented by man, has been exploited of late in the Pathé film, entitled "The New Exploits of Elaine," episode "Shadows of War."

The illustration herewith shows the new fangled wireless antenna invented by "Craig Kennedy," the master scientist of this remarkable film story. In the photo are shown his assistant and also the heroine of the story in the person of Miss Pearl White. "Craig Kennedy" is seen holding the miniature wireless torpedo which possesses remarkable devastating powers, and in the series of pictures it is demonstrated how, quite like the "Hammond" wireless torpedo, it is possible to send out wireless waves from the radio apparatus and antennæ, as here shown. These waves will cause the little torpedo, carrying terrible explosives, to be directed toward a hostile war vessel and as soon as it comes in contact with the hull of the vessel it, of course, explodes with mighty violence, blasting its target into eternity.

Love, intrigue and science permeate this extremely interesting photo play, including efforts by a foreign government to procure the secret of this wonderful radio torpedo.



Pathe Film Episode Exploiting the "Wireless Torpedo."

cussed for the formation of the new Navy Board of Invention and Development. The idea will be to have this Board meet periodically and to thoroughly look into the merits of any inventions which may be submitted to the Government by the many inventors throughout the country.

It is undoubtedly true that in the past many worth-while inventions have been either smothered, so to speak, forever, or else they have been taken over by foreign governments, owing to inadequate facilities for examining such inventions.

The idea to be followed will be to have this Advisory Board of famous engineers and scientists so balanced as regards its personnel that all distinct branches of applied science to-day will be represented by undoubted leaders in those particular fields. Thus, any inventions submitted to this Board will naturally be given the best and proper attention possible. Proper laboratory and field arrangements are to be made for testing out such inventions in a practical way.

The English, and particularly the German, governments have long recognized that scientific men can help very materially in developing proper equipment and machinery for the defense of the nation. Such farsightedness will always repay a thousandfold the development expenses incurred, and it is the rankest kind of folly to expect that we or any other nation can even hope to cope with modern war problems with such a proportionately small army and navy as we possess. To offset this is the task of the new Board of Scientists.

SELENIUM CELLS AND RADIO TORPEDOES.

The problem of radio selectivity may be cast aside as one of secondary importance, and the real problem of keeping the enemy from tampering with the torpedo by means of their own wireless transmitter solved by the use of apparatus which will make them their own executioners, says B. F. Miessner in *Purdue Engineering Review*, in discussing radio-controlled mechanisms, etc.

In 1912, while associated with John Hays Hammond, Jr., he developed an apparatus which was called "An Orientation Mechanism." The principle involved in this machine has been applied to torpedo control with this same idea of making it hazardous for the enemy to attempt interference. This orientation mechanism, which has also been popularly called the "Electric Dog" (see June, 1915, issue of this magazine), in its present form consists of a rectangular box about 3 feet long 1½ feet wide and 1 foot high. This box contains all the instruments and mechanism, and is mounted on three wheels, two of which are geared to a driving motor (see diagram), and the third, on the rear end, is so mounted that its bearings can be turned by solenoid electro-magnets in a horizontal plane. Two 5-inch condensing lenses on the forward end appear very much like large eyes.

If a portable electric light, such as a hand flashlight, be turned on in front of the machine it will immediately begin to move toward the light and, moreover, will follow that light all around the room in many complex manoeuvres at a speed of about 3 feet per second. The smallest circle in which it will turn is about 10 feet diameter; this is due to the limiting motion of the steering wheel.

Upon shading or switching off the light the dog can be stopped immediately, but it will resume its course behind the moving light so long as the light reaches the condensing lenses in *sufficient intensity*. Indeed, it is more faithful in this respect than the proverbial ass behind the bucket of oats. To the uninitiated the performance of the psuedo dog is very uncanny indeed.

The explanation is very similar to that given by Jaques Loeb, the biologist, of reasons responsible for the flight of moths into a flame. According to Mr. Loeb's conclusion, which is based on his extensive researches, the moth possesses two minute cells, one on each side of the body. These cells are sensitive to light, and when one alone is illuminated a sensation similar to our sensation of pain is experienced by the moth; when both are equally illuminated no unpleasant sensation is felt. The insect threfore keeps its body in such a position, by some manner of reflex action, as will insure no pains, and in this position the forward flying motion will carry it directly toward the source of light.

The *orientation mechanism* here mentioned possesses two selenium cells corresponding to the two light sensitive organs of the moth, which when influenced by light effect the control of sensitive relays instead of controlling nervous apparatus for pain production, as is done in the moth. The

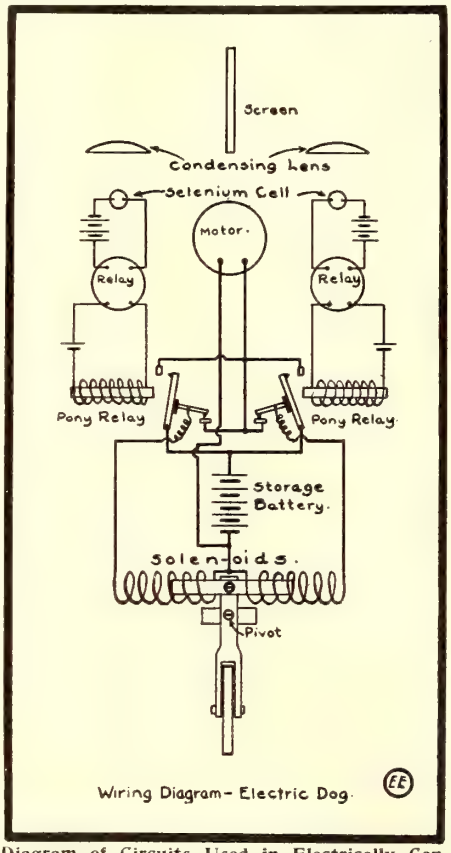


Diagram of Circuits Used in Electrically Controlled "Dog" Utilizing a Beam of Light and Two Selenium Cells.

two relays (500 to 1,000-ohm polarized preferred) controlled by the selenium cells in turn control electro-magnetic switches, which effect the following operations: When one cell or both are illuminated the current is switched on to the driving motor; when one cell alone is illuminated an electro-magnet is energized and effects the turning of the rear steering wheel. The resultant turning of the machine will be such as to bring the shaded cell into the light. As soon and as long as both cells are equally illuminated in sufficient intensity, the machine moves in a straight line toward the light source. By throwing a switch, which reverses the driving motors connecting, the machine can be made to back away from the light in a most surprising manner. When the intensity of the illumination is so decreased by the increasing distance from the light source that the resistances of the cells approach their dark resistances, the sensitive relays break their respective circuits and the machine stops.

The principle of this orientation mechanism has been applied to the "Hammond Dirigible Torpedo" for demonstrating what is known as *attraction by interference*. That is, if the enemy tries to interfere with the guiding station's control the torpedo will be attracted to him. The torpedo is fitted with apparatus similar to that of the "electric dog," so that if the enemy turns his searchlight on it, it will immediately be guided toward that enemy automatically.

In order that the searchlight used by the control operator may not have this same effect, use is made of a gyroscope to keep the turntable upon which the cells are mounted in a fixed position relative to the earth. In this way, no matter how much the torpedo turns, or in what direction it is traveling, the selenium cells will always face from the shore toward the attacking battleship in the open sea.

By means of two directive antennae, instead of two selenium cells, the same principle may be applied for attraction by interference when *Hertzian* instead of light waves are used. Sound waves might also be utilized in a similar manner, so the sound reaching the torpedo (which would be equipped with two submerged microphones, made sensitive and directive by megaphone attachments) from the pounding of the battleship's engines and other machinery would effect its attraction in a way analogous to the attraction of a source of light for the orientation mechanism. It is just possible, too, that similar apparatus could be used for the detection of submarines or for defense against them.

TWO GREAT INVENTORS WHOSE FORESIGHT DID NOT EQUAL THEIR INGENIOUS ABILITY.

Not infrequently great inventors do not comprehend the significance of the thing they have produced. An interesting anecdote of two famous men of science whose foresight did not equal their inventive ability appears in *Les Inventions Illustrées*.

When Hertz first began to obtain satisfactory results from his now famous researches into the possibility of transmitting electric waves certain men of science suggested that some day similar vibrations might serve to transmit messages through space. Hertz laughed at the hypothesis and assured all comers that his experiments were for laboratories only. Now, after a few short years, it is hard to find a single issue of a daily paper that does not record some noteworthy example of the use of wireless telegraphy.

Likewise with Levassor, the great engineer, who sketched the automobile with such skill that his first design has not been materially changed to this day. After Levassor accomplished his historic trip from Paris to Bordeaux and return at the dizzy speed of about 15 miles an hour his admirers gave him a banquet. During the toasts one of them stirred by the spirit of the occasion, arose and enthusiastically called on the assembly to drink to the approaching day when carriages should travel at the speed of 60 miles an hour. Levassor turned to his nearest neighbor and asked in a quick undertone, "Why is it that after every banquet some people feel called on to make fools of themselves?"

LAKE HOPATCONG, N. J., HAS RADIO CONTROLLED BOAT.

A motor boat on Lake Hopatcong, N. J., is operated by wireless from a tower at Woodport. It has a mast at each end, with five projections on one and seven on the other. James Wilson, New York, owns it.

How Telephone Transmitters and Receivers are Made

(Concluded)

ILLUSTRATION 6 and 7 portray the make-up and assembled views of the watch-case receiver. The reason why the longer style of receiver is employed for practically all commercial "Bell" equipment is because this design permits of placing longer and very powerful permanent steel magnets in it. The watch-case receiver is used extensively for telephone work also, especially as an auxiliary receiver, so that the person using a long-distance line may have a receiver at each ear, thus gaining the utmost efficiency acoustically by acting on both ears simultaneously.

For wireless telegraph and telephone work the watch-case receiver is the only practical form available so far, as the operator has to have a pair of receivers strapped on his head for hours at a stretch. The present wireless receivers are highly perfected indeed and, as their manufacture covers all the more important steps of this specialized industry in general, this discourse will conclude with their more important construction details.

First let us look at Figs. 4 and 6, where the component parts of the wonderful telephone reproducer of speech are depicted. Here we see the cap 1, made of hard rubber or composition. This threads onto the end of the receiver shell 5, and between them they clamp by its circular edge an iron diaphragm 2, about 2 inches in diameter. This magnetic (iron) diaphragm is acted upon constantly by a strong magnetic field created by a hard, magnetized steel member 4, of U section for long-type receivers and of circular or ring section for watch-case receivers, as Fig. 6 shows.



Fig. 7. Ultra-Sensitive Telephone Receivers Designed for Wireless Work.

On the permanent magnet 4 is mounted a pair (sometimes only one) of soft iron pole pieces on which are wound many turns of fine insulated copper magnet wire. For all regular telephone work the coils have a total resistance of 75 to 80 ohms. Wireless receivers have from 1,000 to 3,000 ohms resistance each usually, as the current used is very minute, or a few millionths of an ampere.

Each receiver shell, of course, carries suitable binding-post terminals 7, or some receivers have no posts. An insulating disc 6 (Fig. 4) is sometimes secured to the end of the shell 5 to carry the posts 7.

What we read previously regarding the scientific research on diaphragms for the transmitters holds good here also; only in that here the diaphragm is necessarily to be magnetic in character or at least must have an iron center. The design of the caps has been very thoroughly gone into, regarding their acoustic properties, etc.

The following details of manufacture applying to the wireless receivers will give a good idea as to the amount of fine work involved in their successful production.

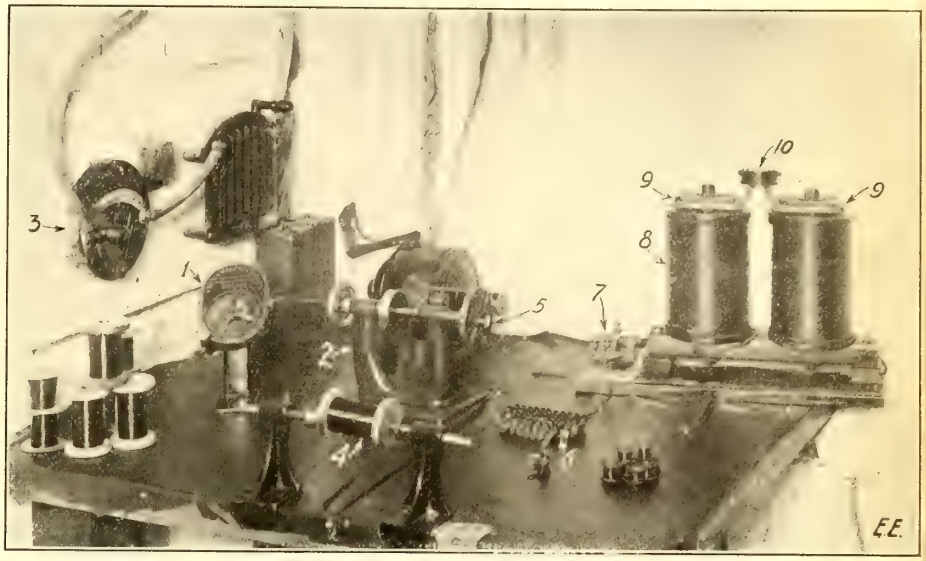


Fig. 8. Showing a Corner of the Winding and Magnetizing Shop Where Wireless Receivers Are Built.

The photograph (Fig. 8) shows one of the winding and magnetizing tables used in making the *"Electro"* radio receivers.

Materials Used.

The vital items in any receiver are the following: The permanent magnets, the wire used, the pole pieces, the diaphragms.

The permanent magnets in all wireless receivers are made of the highest grade tungsten steel, manufactured in Sweden. After the magnets are blanked or punched out to shape they are hardened glass hard. There is a big waste in this process, as many pieces warp so badly that they cannot be used. Each blank is then tested for hardness by an inspector and no blank that can be scratched by a file is acceptable. Such blanks are scrapped. Consider that this steel costs from 35 to 40 cents per pound before blanking, when domestic steel can be had for from 16 to 20 cents. Then consider that but 70 per cent. of the blanks pass inspection, and that a pound of the steel does not furnish many blanks indeed.

The pole pieces, which perform a very important function, must be of the softest possible iron. Nothing but the best grade of inspected Swedish iron will do, and not all grades are satisfactory.

The wire used in the receivers is imported enamel wire. It is No. 43 B. & S.—a wire so fine that the eye hardly perceives it. Only a specially trained operator can wind it on account of its great fragility.

There is at present no suitable No. 43 enamel wire made in the United States. None seem to have the high insulating values of the European wire, and the domestic wire of this size, furthermore, tears so easily that it cannot be used in a high-speed winding machine.

There have been some controversies as to the use of enamel wire for wireless receivers in the past. Exhaustive comparative tests have shown that enamel wire is infinitely more efficient. We cannot here go into a lengthy technical discussion as to the great merits of enamel wire; suffice it to cite the following: No one will deny that the more (ampere) turns one can wind on a given core, the better the electromagnetic results, always bearing in mind, of course, that the nearer the winding to the core the more efficient the electro-magnet will be. Thus, previously these receiver spools were wound with 5,700 turns of No. 44 B. & S. silk wire. Now there are used 6,600 turns of No. 43 B. & S. wire—a heavier wire (carrying more current) and winding almost 1,000 more turns wire in the same space, without increasing the distance between the pole piece and the last layer. This example makes it clear why the present highly perfected receivers are so infinitely more sensitive than they were previously.

"Resistance" is a very empty quotation in connection with a radio receiver. Thus, if we could use German silver wire in receivers it would be possible to save a large amount of money in manufacture. Of course, it is absolutely impossible to use this wire, for the reason that resistance wire "chokes" almost all signals. Not even satisfied to use good copper wire, the specifications for enamel wire invariably call for the highest grade electrolytic copper. This costs quite a little more, but it is possible to get from 1 per cent. to 3 per cent. better conductivity—an appreciable amount when we wind over 6,000 turns of wire on a bobbin.

The diaphragm is one of the least understood parts in telephone engineering to-day. The highest authorities have written books and pamphlets about it, there have been endless discussions, and it is quite safe to say that some millions of experiments have been made, in order to find out just how a diaphragm works. We only know this: We know mighty little as yet. In H.

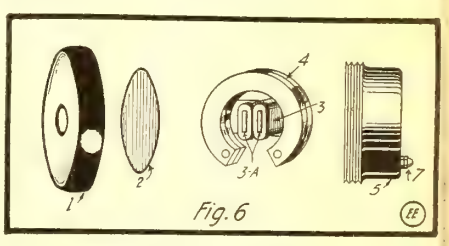


Fig. 6. Details of the "Watch-Case" Telephone Receiver.

Gernsback's laboratory, at New York City, can be found several hundred diaphragms made of strange materials, as well as in strange shapes. There are diaphragms of pure nickel, some of the new magnetic al-

loys, some made of the latest silicon-transformer iron, some with curious holes and curious laminations, some made of iron wires, some made of mica with iron center, etc., etc. Even when blanked out from the best calendered sheets, 25 per cent. of the diaphragms have to be scrapped. They do not all come absolutely flat. Some will be dished, some warped. Neither will the most careful inspection always reveal small defects; for when the receivers are finally assembled some will give a noise instead of a clear note. Thus it will be seen that the insignificant diaphragm is a very important as well as costly item.

Winding.

The most important as well as interesting operation is the winding of the very small telephone bobbin. A specially constructed machine does this work. Fig. 8 shows it; 1 is the automatic revolution counter, which counts the turns of wire on each bobbin. Each style receiver bobbin is wound to a certain number of turns. Thus each bobbin of a 1,500-ohm receiver is wound to 6,600 turns, while each bobbin of a 1,000-ohm receiver is wound to 5,500 turns, and so on. When the hand of the dial arrives at the, say, 6,600th turn, a bell rings and the operator stops. As the wire is remarkably uniform, the resistance of each bobbin will not vary for more than 1 to 2 ohms. The winding machine proper 2 is operated by an electric motor. The control of the machine is foot-operated. The speed regulator is shown at 3. The fine wire supply-spool is shown at 4, while the bobbin 5, in process of winding, is held in an ingenious chuck. Completed bobbins are shown at 6.

Only a thoroughly experienced female operator can wind the No. 43 wire at a high speed without having several breaks in each bobbin. It is a very hard task at best, very trying as well as tiring. It is also necessary to operate the winder at a high rate of speed, as else the wire does not "pack" tight enough. Thus an inexperienced operator can only get about 75 per cent. of the required wire on its bobbin. Naturally the machine must run very steady and smooth to obtain the correct results. After the bobbins are wound and equipped with lead wires they are tested by means of an ohm-meter. Those that test either too high or too low are discarded. The bobbins next go to the female assemblers who make up the complete receiver. Before they leave the assemblers' hands, however, the receivers undergo various tests and several inspections.

Calibrating.

The receivers are now placed in trays, each tray containing some 60 receivers. They are then taken to the calibrating machine, where the pole pieces, as well as the receiver shell edge, are machined down within 1/5000 of an inch accuracy. For it is of the utmost importance that the pole pieces are of quite equal height, and that the edge of the casing be a certain few thousandths of an inch higher than the pole pieces. Also the rim of the casing must be absolutely smooth and even as well as absolutely parallel with the pole pieces. This calibrating is a very tedious operation and can only be performed by skilled mechanics having long experience. This calibration process takes from eight to 10 minutes for each receiver. After the receivers have been calibrated they are inspected by means of a micrometric appliance to make sure that the pole pieces come to 1/5000 of an inch parallel with the rim. If the variation is too great the receiver must be recalibrated.

Magnetizing.

After calibrating, the receiver is ready to receive its magnetic baptism. Fig. 8, at the right, shows the apparatus that does it. The extremely powerful electro-magnets connect without any resistance to the 220-volt power current. A large manipulating key 7 serves to close and break the current, which circulates around the spools 8. When energized, this electro-magnet is capable of lifting over 500 pounds. Only a very powerful electro-magnet produces satisfactory receivers.

On top of the spools we see the adjustable pole pieces 9 9. On top of these the telephone receiver 10 is now placed by the magnetizing operator. The current is then turned on and broken a number of times, in a peculiar manner, while the receiver undergoes several mechanical treatments to age it. After a few minutes the receiver is completely magnetized, and is now tested once more, this time to ascertain if it is magnetically strong enough. The receiver, if passed by the inspection, now goes back to the assembling department. Here it is cleaned thoroughly and polished. Certain parts inside are then enameled and lacquered. After drying, the diaphragm, as well as the hard-rubber cap, is put in position and the receiver is finished. The receivers are then assembled on the head band, the cords are put on and the head set is ready for the final tests. The first test is for resistance. If this has been found correct the completed receivers are sent to the wireless room, where, by means of several ingenious instruments, the phones undergo several tests for sensitivity. Those not checking up with the standard are returned to the factory.

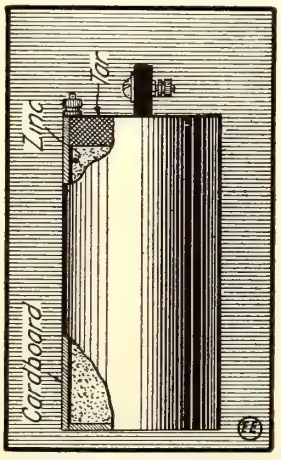
The final, supreme test is the wireless test in actually receiving signals. Phones not sounding clear and sharp are returned to the factory to be made over.

This completes the receivers. Each set is now tagged and signed by the tester, and the phones are then ready for packing.

The "Bell" receivers, etc., go through the different operations just mentioned, and in many cases they are tried out on *"artificial lines"* for talking power, as the inductance, capacity and resistance of the line all tend to affect the performance of the receiver as well as the transmitter. Standard transmitters are tested usually on 28 to 30-mile circuits in the testing laboratory. The phonograph has not substituted the human voice for these tests, strange as it may seem.

WAR AFFECTS CHANGE IN DRY CELLS.

Due to the present war conditions, which



have caused the market price of zinc to "sky-rocket" to dizzy heights, or in fact to about three times what it originally cost before the war, dry cell manufacturers have evolved a new scheme for cutting down the cost of the zinc outer shell electrode of such batteries.

As the sketch herewith shows, the zinc now is in the form of a very thin shell, only extending as high as the active element in the battery. At the bottom of the cell it simply extends to the base of the compound element and no zinc disc is used as a bottom, as formerly. Also, to protect this thin zinc shell, a heavy cardboard covering suitably impregnated to withstand the action of the chemicals is placed over the entire battery.

ABOUT RADIO TORPEDOES.

Several well-known electricians have expressed the opinion that the new wireless torpedo will be ineffective, owing to the liability of its control being lost, through interference by waves from other wireless sending appliances. This objection was raised when the idea was first advanced by Nikola Tesla, but it is claimed by the inventor of the Hammond system of wireless direction and operation that this liability has been eliminated. In a long series of tests made by the operators of the wireless outfit on the United States steamer "Dolphin," said to contain the strongest wireless sending plant in the United States, interference was shown to be impossible until within 250 feet of the torpedo.

Voting Results.

It gives us pleasure to publish herewith the final results of the voting contest between the readers of the *Electrical Experimenter.*

In the June issue we printed a Voting Blank, asking our readers to fill it out by giving their preference of the various departments. The idea proved a huge success.

It was astonishing as well as gratifying to the publishers how much interest was evidenced in this contest. A surprising and quite unexpected feature was that 68 per cent. of the voters thought so much of their magazine that they did not want to cut out the voting blank. Instead, they copied it on a piece of paper! Frankly, we had never thought of that!

Up to July 24, 6,286 votes had been received, and they are still coming from all parts of the globe—China and Brazil included!

Six thousand one hundred and fourteen were satisfied with the magazine as a whole; 212 made valuable suggestions—some of them very valuable; 172 criticised us—some harsh, some mild—on various subjects. Some of these wanted nothing but wireless, some nothing but "How-to-Make-It," and so on.

On the whole, every voter seemed well satisfied. The following table accurately shows the tabulated preferences of 6,286 readers. It requires no comment, except that we will be guided by the wishes of our readers and we will give them exactly what they ask for, in the proper proportions:

"How-to-Make-It" Dept.	1
"Wireless" Dept.	2
The Constructor	3
General Electrical Articles	4
"Münchhausen"	5
Electrical Experiments	6
Among the Amateurs	7
Question Box	8
Magazine Review	9
Latest Patents	10

The average age of our voters proved to be 18. The extremes were as follows:

Of the 6,286, 12 were 11 years old, and 16 were 48 years old.

After passing the 20-year stage we found 96 to be 21 years old and 64 were 22 as well as 29 years old.

How to Construct a Galvanometer.

A USEFUL galvanometer is easily made up as described below. The woodwork used presents no difficulty. Any well-seasoned wood can be used—in the present instance some odd pieces of mahogany came in very well. After the frame has been made, wrap several layers

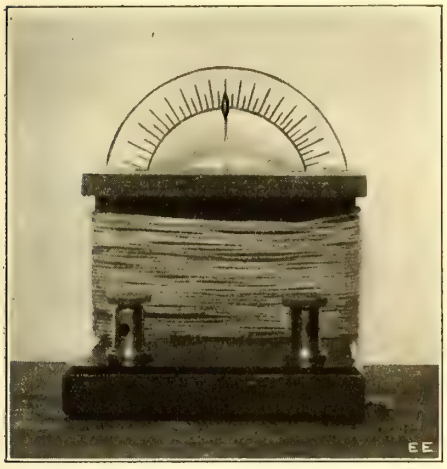


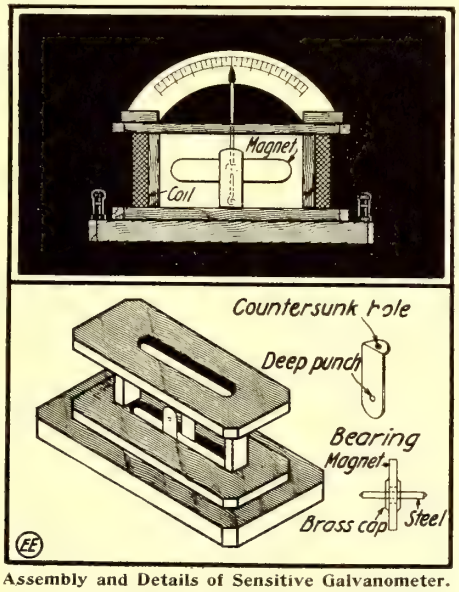
Photo of Complete Galvanometer. (Four Posts Being Used; Only Two Shown.)

of wire around the bobbin itself. The wood can be finished to the fancy of the maker. A good rubbing with linseed oil makes a quick and lasting finish and safeguards against dampness.

There are two magnetic windings. The first is a high resistance winding of two, even, close layers of No. 30 D.C.C., although a little finer would be even better. The beginning and finishing ends are led through two small holes at one end of the bottom flange. This winding is then given a good coat of shellac varnish, and a strip of brown paper is then laid over it which is also shellacked. The outer winding is two close layers of No. 20 D.C.C., also well shellacked, forming the low resistance coil. A finishing cover of varnished paper can be laid over this, if thought necessary. The two ends of this winding are taken through two holes in the other end of the lower flange.

The magnet is a strip of steel cut from a small hack-saw blade. It may be annealed in a Bunsen gas flame to be soft enough to cut and drill. Round the ends nicely, and exactly in the center drill a 3/16-inch round hole. Now take a short piece of ¼-inch round brass. Shoulder (in a lathe) one end down to 3/16 of an inch for about ⅛ of an inch; pass this small end through the hole and rivet it over. Cut off the remaining ¼-inch end, leaving 1/16 of an inch projecting from the steel, and you will have a nice boss in which to mount the spindle. Now place the steel in a bright, clear fire, and as soon as it has reached a dull red heat lift it out and at once drop it into a basin of cold water. It will now be very hard and brittle. Next carefully clean it up with fine emery cloth and drill a 1/16-inch hole exactly in the center of the brass boss. To make the spindle get a knitting needle (steel, of course) that is just a shade too large for the hole. Very carefully force it through with gentle blows. File down the ends of the spindle until they are brought to points, which must be central and finish quite smooth. The final smoothing can be done with a narrow strip of the finest emery cloth glued on a slip of wood. Do not make the points with too long a taper. When finished, the over-all length of the spindle should just exceed one-half inch. Now you may magnetize the steel blade as strongly as you can—either by stroking it many times with one pole of a strong magnet, or by passing a strong current of electricity for a minute or two through a coil of wire wound around it.

The pointer and balancing counterpoise can now be attached. They are made from a piece of the No. 20 D.C.C. wire with the insulation removed, and are fastened to the brass boss with just a drop of solder. Just a word of warning here: Do not make the soldering too long a process, or the heat of the "iron" will weaken your magnet. To avoid this you might magnetize the steel after the soldering is done, though it is not then quite so convenient. The lower end of the counterpoise is formed of a small loop of the wire filled with a little blob of solder. By holding the ends of the spindle lightly between the finger and the thumb, a little manipulation



Assembly and Details of Sensitive Galvanometer.

of the counterpoise will cause the magnet to rest horizontally with the pointer vertical.

THE CONSTRUCTION OF AN EXPERIMENTAL ARC LAMP.

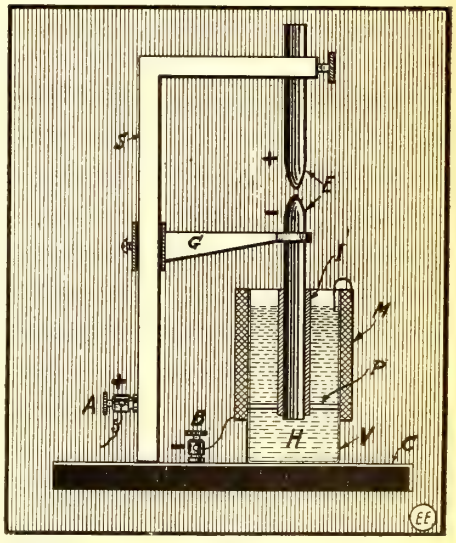
An arc lamp, whereby the essential features of this illuminating device can be demonstrated, can easily be made as shown and described in this article. While the lamp here shown, does not have the refined feeding mechanism with which commercial arc lamps are provided it will operate under the conditions specified and will show how electrical energy can be converted into light.

The electrodes *E* are lengths of electric light carbons. The upper carbon is supported by an upright *S*, which should be of metal, inasmuch as it comprises part of the electrical circuit. In operation the current should enter the binding post *A* and leave at the binding post *B*. The base *C* is a block of wood. On this base is carried a glass or metallic vessel *V*. An iron sleeve *I* should be fitted over the lower end of the negative electrode. This sleeve should fit snugly so that the friction between it and the electrode will hold it in place. This sleeve has two functions. The first is to provide good electrical contact between the negative electrode and the mercury in which its lower end floats, the second is to provide a supporting medium for the guide pins *P* which will be described later.

The metal guide *G* which holds the negative carbon in line with the positive carbon is supported on but insulated from *S*. Three pins *P* screwed into the lower end of the sleeve *I* guide the lower end of the negative electrode.

The solenoid *M* consisting of about 100 turns of No. 14 gauge insulated copper wire is wound around the upper part of *V*. One of the terminal wires of this solenoid connects to the binding post *B*, while the other dips into the mercury *H* with which the vessel is filled.

Now we will trace the electrical circuit through the lamp. The current enters at *A*, passes through the metal stand *C* to the positive electrode. Then it arcs to the negative electrode and passes down it and into the mercury. The path is then through the coil or solenoid *M* and to the negative binding post *B*. With this, as with every other arc lamp, a resistor of a few ohms resistance and of sufficient capacity to carry the current of the lamp, must be connected in series with the lamp. Every electric arc must have, for reasons which cannot be discussed here, in series with it, either a reactance or a resistance as "ballast." The lamp here shown when connected as described will operate on a 110-volt circuit. The principle of operation is this: When the switch is closed and current is permitted to pass through the lamp, the negative electrode which ordinarily is forced upward by the pressure of the mercury into contact with the positive electrode, is drawn downward by the electromagnetic action of the solenoid *M*. That is, when no current is passing through the solenoid the lower end of the carbon encased in its iron sleeve floats in the mercury just as a cork floats on water.



Construction of Simple Automatic Feed Arc Lamp.

The mercury buoys the negative carbon up against the positive carbon. As the lamp burns the electrodes are consumed, which increases the distance between them and tends to increase the resistance of the circuit. The current through the solenoid

M is thereby decreased and its electromagnetic effect proportionately reduced, hence the negative carbon is permitted to rise. It is evident therefore that this lamp feeds itself automatically.

It is not essential that carbon be used for the electrodes of this lamp. Metallic electrodes can be used instead. While the metallic electrodes will burn away much more rapidly than those of carbon, they will provide light of certain qualities that may be desired to satisfy certain specific conditions. For example, with the positive electrode of steel and the negative of carbon a light which is very rich in actinic rays is produced. This kind of light has the property of acting very rapidly on photographic plates. Actinic rays of light are sometimes called ultra-violet rays. Where experiments are being made with ultra-violet rays, the eyes must be shielded from their effects by *clear glass spectacles*. Otherwise inflammation of the eyes and other ailments may be produced. Clear glass has the property of sifting out ultra-violet rays—they cannot pass through it. Contributed by

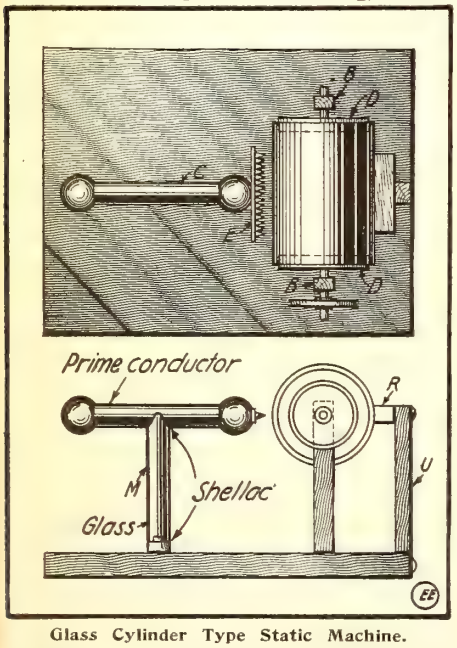
J. A. GILMAN.

THE CONSTRUCTION OF A FRICTIONAL ELECTRIC MACHINE.

A FRICTIONAL or static electrical machine can be made as shown in figure. With this device many interesting experiments in static electricity can be performed.

In any frictional machine it is necessary that some insulating material be arranged to rub against a dissimilar material. Theoretically, the friction or contact between any two dissimilar materials will develop frictional electricity, but it has been found in practise that the friction of glass against a certain amalgam, which will be described, gives the best results. The apparatus shown herewith is an arrangement whereby a glass cylinder is made to rub on an amalgam.

The glass cylinder can be about 4 inches outside diameter and 6 inches long. This cylinder can be cut from a jar or bottle. Or else the jar or bottle can be mounted between two bearings without cutting, after a



Glass Cylinder Type Static Machine.

manner that will immediately suggest itself to the experimenter. If a glass cylinder is used, two disks of dry wood *D* are fitted into its ends and cemented there with shellac. The axle is a metallic rod about 8 inches long and ¼ inch in diameter. This axle should be cemented into the end pieces *D* with shellac. The bearing blocks *B* should be of dry wood about 6 inches high, 1 inch wide and ⅞ inch thick. Each is fastened in place on the base block by a couple of flathead screws, turning up into them from the bottom of the block. A ¼ inch hole is bored in the upper end to accommodate the axle.

If the cylinder is to be turned by hand a wooden crank is arranged at one end of it, but if an electric motor is available for driving it a wooden pulley is mounted on and cemented to one of the axles. All of the wooden parts of the machine should be thoroughly dried and varnished with two coats of shellac. The cushion *R* is a block of wood about 4 inches long and ⅞ inch wide. It is wrapped with five servings of flannel and then covered with two additional servings of silk cloth. This cushion is secured after the cloth has been wrapped around it to the end of a wooden upright *U* with one or two wood screws. Before the cloth is wrapped on the cushion the edge of the cushion block that is to bear against the glass cylinder should be rounded out somewhat so that it will approximately have the curvature of the cylinder. After the cushion block and upright are in place the cloth on the block should bear firmly against the cylinder.

In operation the cushion should be well coated with an amalgam compound as follows: Melt together two parts of zinc and one of tin. While these metals are fluid add to them six parts of mercury. Now pour this alloy into a wooden box and agitate the box until the alloy is cool. Before applying the amalgam to the cushion it should be mixed with a small amount of lard so that it will stick to the cloth.

The prime conductor *C* is made of brass tubing. A piece of tubing having an outside diameter of 1 inch and a length of about 4½ inches will serve the purpose. At each end of this tube a brass ball about 1½ inches in diameter is soldered. The ball should be smooth. Such balls can be obtained from window curtain fittings. The comb *E* is made by inserting in a strip of sheet brass about ⅜ inch wide and 4 inches long a number of brass tacks or brads. These points should not be more than 3/16 inch or ¼ inch apart. The head of each point should be soldered to the comb strip. This comb strip is now soldered to the prime conductor *C* as shown.

The prime conductor support *M* is shown as a piece of glass tubing, but a stick of sealing wax can be used. Glass is the better material. At its lower end *M* fits over and is shellacked to a wooden boss, which is held to the base with a wood screw. At its upper end the prime conductor *C* is cemented to *M* with sealing wax or shellac. After the prime conductor is fixed in position it should be of such a height and so arranged that the points of the comb will be no further than 1/16 inch from the glass cylinder. Furthermore, the points should be on a level with the center line of axis of the cylinder.

In using this frictional machine it should be carefully cleaned with a dry rag or a camel's hair brush and should be warmed before a fire to drive off any surplus

(*Continued on page* 208.)

HOW TO MAKE A "BUG" KEY.

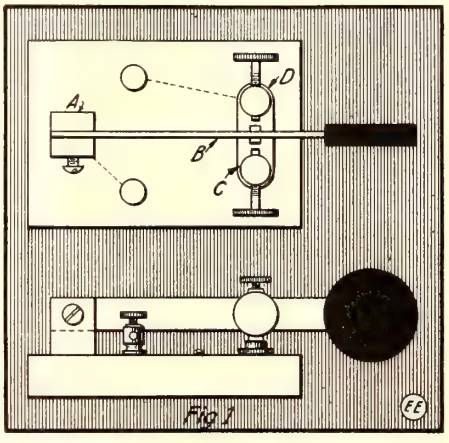
"Bug" is the name given double-contact telegraph keys that use a horizontal instead of a vertical motion. Although these do not possess all the advantages of the automatic keys, they are far superior to the ordinary key and therefore worthy of a place in every radio or telegraph station.

Ease of construction is one of their advantages, and this will be apparent by a glance at the drawing. I have given all the dimensions necessary, but a few words will not be out of place.

A piece of hard rubber is used for the base, but fiber, marble or hardwood may be used with good results. The holes are drilled with a No. 19 drill, or large enough to pass the 8/32 screws as used to hold the various parts to the base. The edges of the base may be beveled off with a file.

The standard A to hold the spring is made from a piece of ½-inch square brass rod ⅝ inch long. This has a hack-saw slot ⅜ inch deep cut in it and two holes drilled and tapped as shown.

The lever B, of phosphor bronze or spring brass, is 3⅜ inches over all without the knob attached, ⅜ inch wide and ☆ inch thick. This will be found to have about the proper tension, and no adjustments will be found necessary. The lever has a piece of silver wire riveted into a hole in the

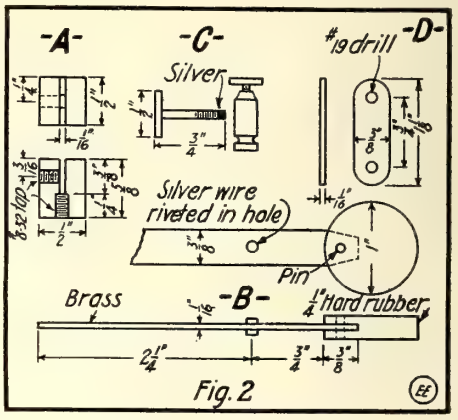


Making a "Bug" Telegraph Key.

position shown in Fig. 2, and is fastened to the knob by inserting one end into a slot cut into the knob and held there by means of a small pin driven through, as is also shown.

Four common binding posts, the two contacts C C (Fig. 2) and the small brass strap D complete the list. The contact pieces C C have short ends of stout silver wire soldered onto their heads.

Assemble these parts as per drawing and you will have one of the handiest instruments you could own. The knob is held lightly between the thumb and forefinger and moved from side to side, remaining in each position long enough to give the necessary dot or dash.



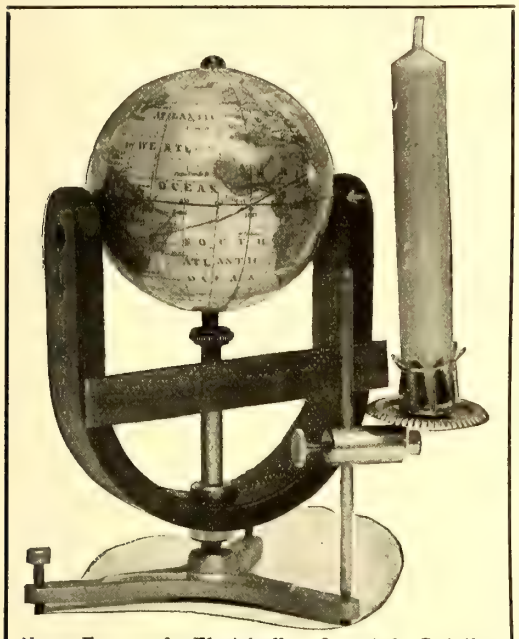
Details of "Bug" Key.

If the base is polished and the brasswork nickeled, the appearance of the "bug" will be greatly improved. Contributed by

THOMAS W. BENSON.

NOVEL EARTH GLOBE WHICH ROTATES ELECTRICALLY.

A striking model of a revolving earth globe, on which is painted a map of the earth in the regular way, has recently been brought out. This model has a sphere A,



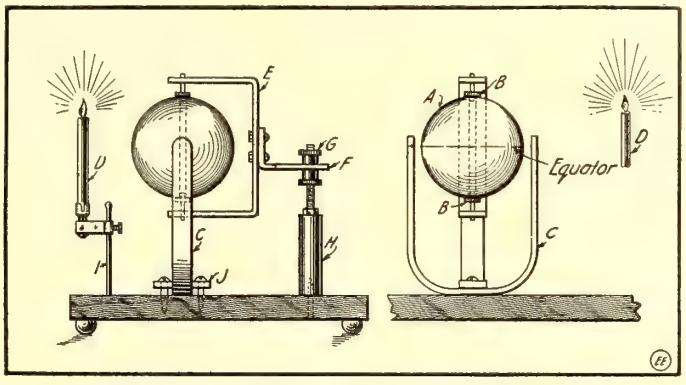
New Form of Electrically Operated Rotating "Earth" Model.

delicately mounted between the poles of a strong permanent steel magnet C, as the illustration shows. The sphere measures 2½ inches in diameter, but this may be varied somewhat in case the experimenter intends building one.

The peculiar part about the sphere is that the upper half of same is made of very thin copper, which can be provided for by using a hardwood ball of the proper size and hammering the copper over same with a wooden hammer in the same way that coppersmiths do such work. Attached by glue or otherwise to this upper copper hemisphere is a lower hemisphere made of Bristol board or paper, etc. Suitable supporting means is suggested in the sketch, E and F being made from brass as well as the rest of the parts, excepting the steel magnet C. This magnet may be secured to the base by a piece of brass or wood J, together with a few wood screws. A brass rod I serves to support a candle holder and candle D, as observed.

This model is found to operate best when the source of light or candle flame, etc., strikes the sphere midway between the equator and the upper pole of the sphere. *Even the light from a match will cause the sphere to rotate.* In some cases a slight push may be necessary to start it, but invariably it does so automatically. The vertical position of the sphere is important and it should be tried out at different heights with respect to the magnet poles.

Why does the ball turn? is the question often asked. No one knows precisely. There are many theories or "explanations." Among them is that of the German scientist, Albert Lotz. He suggests that magnetic forces, in conjunction with the sun's heat, are constantly operating like spiral tides or gently wheeling currents to turn our globe around. This little revolving earth model is intended to illustrate this theory. Whether the theory be true or false, it is interesting to see it given such clear and attractive expression.



Details of Construction for Rotating "Earth" Model.

A DRY STORAGE BATTERY.

The average cyclist seems hardly to appreciate the value of electric lighting for his bicycle; he is accustomed to using the old form of oil or gas lamps and only recently several manufacturers have brought to the attention of the public electric dry battery bicycle lamps.

The main disadvantage is in the dry cells used. These batteries are not intended for continuous use, but for intermittent service, and the question then arises, "Why may not a storage battery be used?" This is readily answered in the following: The regular storage battery, as made to-day, contains a very corrosive acid, known as sulphuric acid; the container of same must be kept open by means of a vent during the working of the cell, as gases are constantly being given off. For this reason they cannot be readily used on bicycles, as any vibrations would cause the acid to spill, resulting in serious damages.

The writer, having experienced the above-mentioned difficulties, gives herewith two simple methods for converting a liquid storage battery into a dry type, which may be used in connection with a vehicle or for other portable work, with success. The first method consists of the following:

Make a paste mixture of some ordinary sawdust, immersed for 20 hours in a zinc chloride solution, which can be obtained from any chemical house at 10 cents a pound. After the sawdust has been saturated in the chloride solution, it should then be allowed to dry for about 12 hours. Then wash the sawdust in several hot waters to thoroughly clean it, then dry again. Having done this, fill the storage battery with this mixture and add the sulphuric acid, having the same specific gravity as if the battery were ordinarily used. It should then be charged as usual, and it will be found that by shaking or inverting the battery, the solution will not spill; the sawdust mixture has absorbed the acid and at the same time is pressing against the plates, giving them a live acid surface.

The second method: Fill the cell full with ordinary glass wool, and add the acid until the wool is completely saturated. This glass wool may be procured from glass blowers.

It will be found that the above-mentioned methods of converting a wet storage

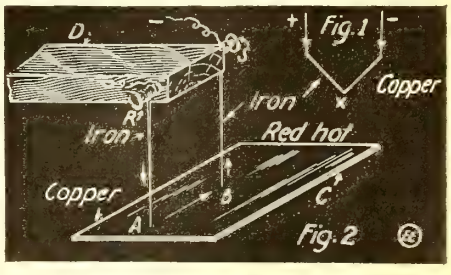
(*Continued on page* 208.)

DEMONSTRATING THE PELTIER CURRENT EFFECT.

The materials required for this experiment are a few good primary cells—or, better, a storage cell—a flat piece of copper sheet, two binding posts, a few steel needles and a small piece of wood. Thus equipped we are about to demonstrate the "Peltier effect."

First let us state what that effect is, says R. E. N. in *Model Engineer*. Referring to Fig. 1 if we pass a current through iron and copper wires twisted together at X to form a series circuit the junction will be *heated* when current passes from iron to copper and *cooled* when current flows in the opposite direction. This effect is not the ordinary heating effect of an electric current. As the temperature increases the Peltier effect decreases till it becomes zero at 280° C. (535° F.); at higher temperatures it reverses, so that heat is developed at the junction when current is sent from copper to iron and cooling is produced when current flows from iron to copper. It must be understood clearly that ohmic resistance at the junction produces the same heating whichever the direction of current flow. The Peltier effect simply adds to or subtracts from this heating.

Suppose now that we fix binding posts R S in one end of a piece of wood D, Fig. 2, and clamp leading-in wires and steel needles in these terminals, so that when the other end of D rests on the table the points A B rest evenly on the sheet of copper C. Current can now be passed from R to S through a steel needle, the copper plate and another steel needle in series. On starting the experiment the needle tips are cool and the junction A (iron to copper) is heated and the junction B (copper to iron) is cooled by the Peltier effect. If, however, 4 or 5 amps. be passed through the circuit the needle tips soon get warm, because their section is very small and their resistance therefore relatively high. The junction A reaches the critical temperature (280° C.) before B; but soon both needle tips are hotter than this, and then the Peltier effect is reversed and the tip B becomes hotter than A, so that ultimately B becomes red hot, while A is still invisible in the dark (the lowest red heat visible in the dark is about 335° C. or 635° F., while "dull red" heat is about 700° C. or 1,290° F.). Owing to the small weight of metal in the needle points, the small amount of heat produced or absorbed by the Peltier



The "Peltier Effect" of Electric Currents.

effect produces quite considerable temperature rise or fall, and thus permits one tip to become red hot appreciably sooner than the other. If the current be great enough both needle tips will soon be red hot, but that one becomes red first where current leaves the copper plate. If the weight on the two needles is distributed evenly the needle tip A will become red hot first when current is reversed, thus proving that unequal resistance is not the cause of the phenomenon. A fresh pair of needles should be used often. The effect is best seen in a subdued light.

A GOOD THERMO-ELECTRIC CELL.

The form of thermo-electric cell described below was discovered by J. T. Seebach, a noted German physicist. The cell will prove of interest and moreover is cheaply constructed.

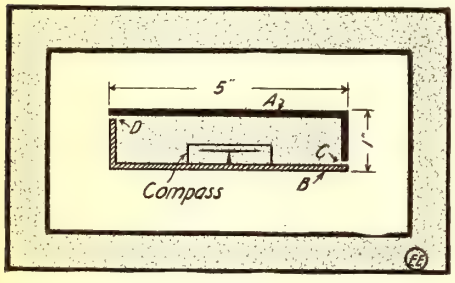
First obtain two metal strips, A and B, about 6 inches long and 1 inch wide; one of German silver and the other of copper. Bend them as shown in figure and then solder the ends together, thus forming a rectangle 5 inches long and 1 inch high.

Now mount a small compass upon the upper side of the lower strip. Place the arrangement upon a non-combustible base and the cell is complete.

To use bring a match or some form of heat near the soldered joints, D or C, and the compass needle will turn slightly, thus proving that an electric current can be generated by heating the union of two dissimilar metals. The wattage of such a cell will be about 1-50 of a watt, and since so much heat is required the cells are not commercially a success, although by using several cells in series-multiple an electric lamp can be lighted.

By soldering two wires to the cell, one to each strip, the following experiments may be tried:

(1) Connect a set of batteries to the two wires and place a drop of water upon the joints. The water will either freeze or boil, and by reversing the battery current the reverse will take place.



Thermo-Electric Cell Which Produces Heat or Cold.

(2) By arranging one corner joint in ice water and the other joint in warm water a current of about 1-12 volt and ¼ ampere may be taken from the two wires, but the wattage obtained in this way will depend upon the following: Surface heated; difference in temperature; metals used; condition of union, etc.

(3) By using antimony and bismuth for the legs of the cell and different patented arrangements experimenters have succeeded in producing a respectable amount of electricity in this way.

Contributed by
WM. R. COTTRELL.

A DRY STORAGE BATTERY.

(*Continued from page* 207.)

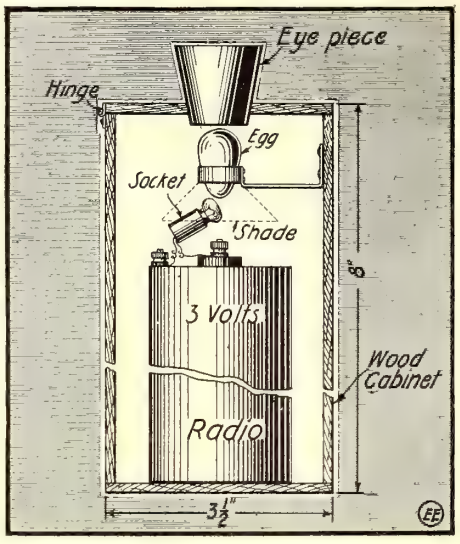
battery to a dry type will be very successful and especially suited to the cyclist, who may use a storage battery as above mentioned for bicycle lighting. Contributed by
S. C.

The Marconi Wireless Telegraph Co., Ltd., reports net profits for the year ended Dec. 31 last of £232,700, an increase of £110,400. The report states that the directors decided to reduce the dividend on the ordinary shares from 10 to 20 per cent., in order to strengthen the financial position of the company.

A CHEAP ELECTRIC EGG TESTER.

The expression "fresh eggs" cannot always be depended upon, and my little device, herewith described, can be used in any suspicious case.

Make a wooden cabinet 8 inches high and 3½ inches wide. Then procure a 3-volt "Radio" cell and place in a box as



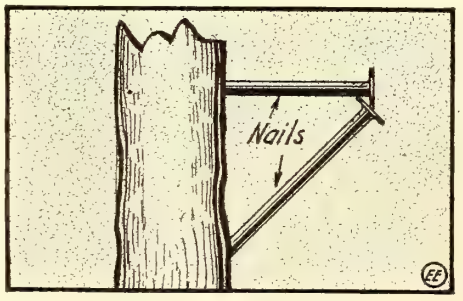
Inexpensive Electric Egg Tester.

shown. In a small socket screw a bulb of at least 2½ volts, and with some stiff wire connect to battery as depicted. Now secure a wooden ring and fasten to a bracket in cabinet. If this cannot be done, make a ring from some very thick wire and tack to side of cabinet. Obtain a wooden cover, and after attaching a plain eyepiece, drill a hole in the center of the cover and fasten to box by hinges. Finally, bend the bulb in position, so that it is just in the middle of the ring when peering into the eyepiece. The hard rubber mouthpiece from an old telephone is a good substitute for an eyepiece.

When the light is turned on and the egg is in place the brilliancy of the bulb gives the egg a dim glow and the freshness is thereby determined by the quality of the glow. The darker the glow, the older the egg. A small lamp shade may be fastened to ring if desired. Contributed by
W. WESTON.

TEMPORARY POLE STEPS.

Cheap but safe pole steps can be made with 5-inch spikes. Spike one is driven in at an angle of 45 degrees, then spike two is driven in horizontally so that it rests on



Pole Steps Made From Nails.

the head of spike one. The wireless experimenter will find these useful for ascending trees and poles to erect his aerial.

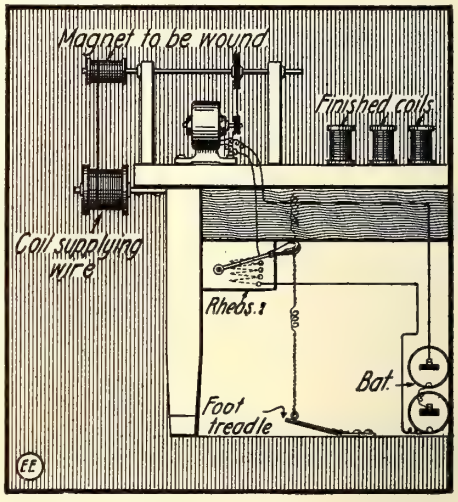
Contributed by E. R. THOMAS.

A SMALL WINDING MACHINE.

Every amateur, I am sure, knows how disagreeable it is to wind a magnet by hand. Herewith is described a simple machine involving only the use of an electric motor, a rheostat and some shafting.

First mount the motor about 8 inches from the edge of your table. Then procure and fasten two wooden posts in an upright position as shown. Before fastening, however, drill a hole on the end of each one, all the way through, to admit a long, slender steel rod. The latter is to be next obtained and a pulley fastened, as shown in sketch. The next step is to fasten a home-made rheostat on the left hand leg of the table and putting it in connection with some cells and one binding post of the motor. The sketch explains clearly all wiring. Now fasten a cord on the handle of the rheostat, attach a spring to it and fasten the end of the string to a foot treadle secured to the floor by hinges. (A piece of board will serve for a treadle.) Lastly, on the left hand corner of the table drive a long, thin nail, but without a head, as otherwise the spool cannot be slipped on and off. The device is now complete, and without a doubt will work satisfactorily.

To wind a magnet, put a spool of wire on the long, thin nail on the edge of the table and slip in a wooden bobbin to receive the wire on the steel rod, which is belted to the motor. By means of the foot treadle the hands can be used to control the winding of the wire evenly and the foot to control the current, by means of



Simply Made Electric Winding Machine for Experimenters.

the rheostat. If the wire begins to wind unevenly, raise your foot, thereby lifting the spring on the handle of the rheostat, which shuts off the current at once. For further operation, press treadle again with foot. Contributed by W. WALLACE.

THE CONSTRUCTION OF A FRICTIONAL ELECTRICAL MACHINE.

(*Continued from page* 206.)

moisture. Then the cushion should be connected to ground—a gas or water pipe, or merely a wire leading to the floor will suffice. Now if the cylinder is rotated rapidly a stream of sparks, that is, a discharge of electricity will pass between the points of the comb and the glass cylinder.

When the hand is brought near the end of the prime conductor a minute lightning discharge will occur between them and an electric shock will be experienced. *Under favorable conditions a spark as long as 2½ inches may be produced.* Any of the usual experiments in static electricity can be readily made with this device.

Contributed by FRED C. ARMAND.

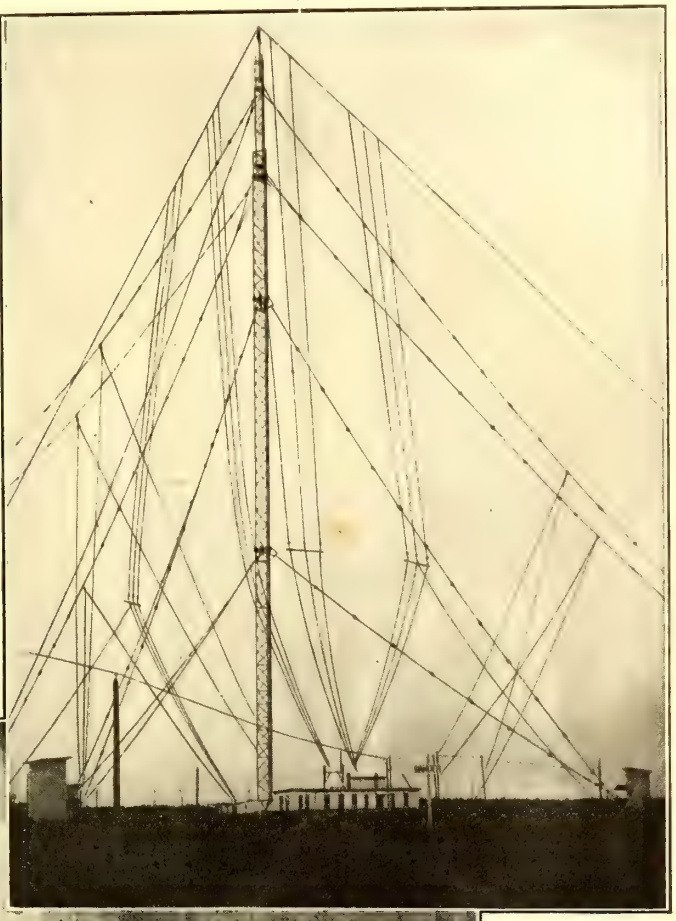
Sayville, the News-Way to Berlin.

NOW that the powerful German Wireless Telegraph Station, located at Sayville, L. I., has been taken over by the United States Government authorities by order of the President, to further the purpose of preserving our strict neutrality, this remarkable plant, about which so much secrecy has always been observed, has become of extraordinary interest to practically every one in this country.

Owing to the great secrecy which has always surrounded this station and the operation of same, there have been many wild tales prepared and published by various newspapers throughout the country, as to many *possible* and also a great many *impossible* schemes, which might have been employed in order to send undecipherable code messages to Germany, via the Nauen station, located near Berlin, which works in conjunction with Sayville in this country.

This plant is one of the largest in the world now, since the two new 400-foot steel towers have been erected and in view of the fact that the dynamo equipment for generating the wireless waves has been increased from about 35 kw. to 100 kw., or in other words the transmitting power has been tripled in order to insure absolute communication, under all conditions and particularly through the heavy static obtaining during the summer weather.

The illustrations herewith show the wonderful aerial structure at Sayville, which towers over 500 feet above the ground. The mast here shown is the central one of the three now available for the wonderfully enlarged antenna system.





Photos (C) by Underwood & Underwood.

Interior View of the Wonderful "Sayville" Radio Station. Above, the Aerial Structure 500 Feet High. Three Masts Are Now Used and 100 Kilowatts.

This station embodies a number of very ingenious and advanced features in radio installations not found in other stations, generally speaking, and about which very little has been said or published indeed. Among these important features are the means by which transmission and reception of signals is effected. To begin with, the high power used at Sayville has always been handled by automatic transmitting keys of the relay type. The operator, as here seen in the picture showing the interior of the station, operates an ordinary Morse key mounted on the desk in front of him. This small key controls the massive relays of the air-cooled type, of which there are three. Each relay has eight series contacts on it, and thus the current is broken through a plurality of 24 contacts. This conduces to rapid and positive operation of the transmitting circuit in sending out the dot and dash signals, which occur, of course, at the rate of many signals per minute. These relays are specially designed and are capable of operating at a speed of 150 words per minute.

Of course, no manual operator can attain a speed of much over 50 words per minute, even in a radio station, but the higher speeds such as mentioned are obtainable with this Telefunken system, as the transmitting has been done for many months and also at present, by means of a perforated paper tape, which is prepared on a machine similar to a typewriter, with a lettered keyboard. Once this tape is prepared with proper perforations corresponding to the dots and dashes of the Continental radio code, it is then passed through the automatic transmitter device, which actuates the heavy current relays aforementioned.

Suffice it to say that everything connected with this plant is of the very best and latest type. Particularly is this noticeable in the reception of radio signals from across the broad Atlantic, as for this purpose it is not necessary for the operator to wear the usual head 'phones on his ears, as will be noticed particularly in the illustration here shown.

Signals coming in from Nauen, Germany, pass through a specially tuned microphonic form of amplifier, which may be observed mounted on the pedestal directly in front of the operator. This am-



The Above "Code" Diagram Shows How Secret Cipher Messages Could be Interspersed Through Regular Messages.

plifier so marvelously increases the power of the signals as picked up by Sayville's antennae that when they reach their final stage they have been boosted sufficiently to enable them to operate a loud-sounding signal horn, so that the signals sound through the room similar to the striking of a piano string. Of course, it is perfectly feasible and possible, if desired, to make a tape record on a register of these signals as they come in, by hooking up the recorder to the final stage of the amplifier circuits.

As recently pointed out editorially in this journal, it is very true that, by means of the usual "cipher" code, it is undoubtedly possible for parties desiring to do so to send through a message which may appear very innocent indeed on its face, and yet when received in Germany, and by referring to a copy of the special "cipher" code involved, a distinct and very useful meaning may thus be carried through by such a message, even though *every person* connected with the Sayville station belongs to the United States Government personnel.

There have been many fantastic stories published in the newspapers, as aforementioned, and particularly with regard to a special invention of Dr. Isidor Kitsee, of Philadelphia, which some have claimed was used for the transmission of secret code signals *interspersed* with the regular signals employed for transmitting via Sayville ordinary-looking messages which the United States censors at Sayville passed through readily enough. While such an invention or code scheme could be used, it is doubtful that it was ever actually used.

It might, however, be of interest to point out how this could be accomplished. The code diagram herewith will show how the scheme would work in practise, and we think it is doubtful whether under ordinary conditions the United States Government censors would detect anything unusual about such a message. Furthermore, it could be *repeated a number of times* with variations, in order to make up a complete code for the alphabet. The fact also remains that such a lengthy repetition of a similar message for a period of several days, it is reported, was one of the deciding factors involved in the Government seizure of this station.

By referring to the code diagram here reproduced there is seen the word "Berlin" with corresponding Continental code dot and dash signals used in transmitting this word via radio. Glancing at the second line, it is seen how the spacing of the dots and dashes in a couple of letters comprising the word "Berlin" could be abnormally arranged. This abnormal spacing, strictly speaking, can be very minute, in view of the fact that if these particular signals were copied on a register at Nauen it would then be easily possible for the operator at that station to note the small difference in these "doctored" signals. By making these spaces different, or by using a certain space in a certain letter to represent a letter of the (cipher) alphabet it would be possible indeed to send a complete code message. By duplicating the same (regular message "apparently") time after time, it would ordinarily not arouse any undue suspicion.

Another scheme which could be followed would be the interposition of additional dot signals in the regular code make-up, as the third line in the diagram illustrates. Note the signal for "B," where an extra dot is added, and also the extra dot which is added in between the letters "E" and "R." It is quite improbable that these would be detected under usual conditions, especially as the messages sent through this station can be transmitted at a marvelous rate of speed.

This "doctoring" of the regular code signals could be managed by a small attachment of an electrical nature, perhaps, which could be fitted secretly to one of the automatic paper tape perforators or to one of the magnetic key transmitting mechanisms so as to abnormally space certain dots or dashes.

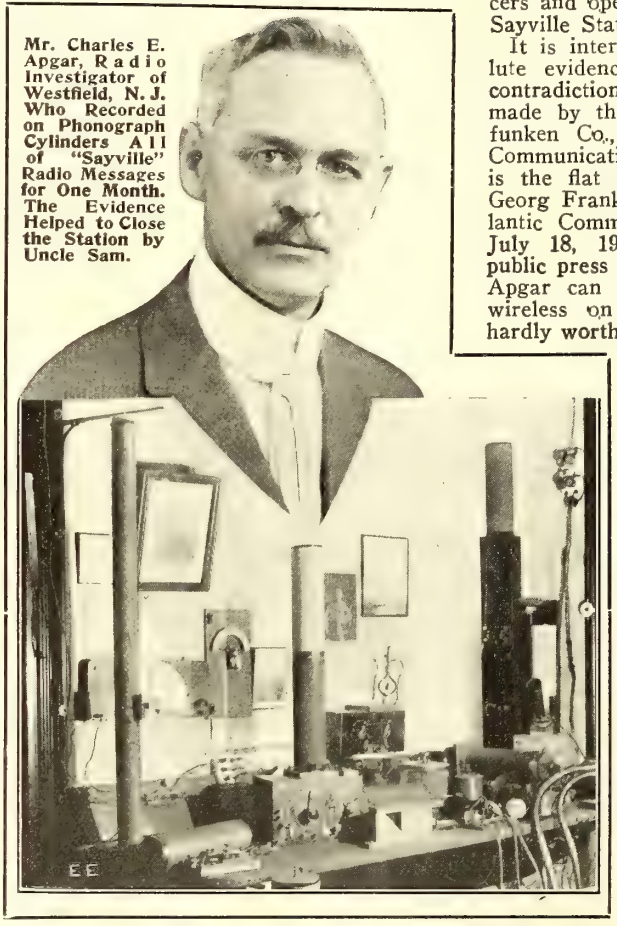
This matter is simply brought out to show that it is possible to conceive a secret cipher code, even in the face of strict censorship as this term is generally interpreted or understood, as for instance, prior to the complete occupation of this station by the United States naval personnel.

Why Sayville Radio Station Was Closed.

ADDITIONAL light has recently been thrown on the matter of the closing of the powerful German radio station at Sayville, L. I., and its reopening by a full Government staff.

A quantity of simple phonographic wax records, which were taken over a period of about one month prior to its seizure by Uncle Sam, were recored at the experimental wireless station of Mr. Charles E. Apgar, at Westfield, N. J.

We illustrate herewith the apparatus in Mr. Apgar's radio station and his wonderful amplifying set, whereby he has been enabled for the past few years to record faithfully all kinds of wireless messages on phonographic wax records. To put the matter briefly, the "canned" evidence that really closed the Sayville station, as far as the Telefunken company's operation of same was concerned, was started back on the 7th of June, 1915, on the advice of the United States Secret Service. W. J. Flynn, Chief of the Secret Service Bureau, took up the matter with Mr. Apgar at that time, and every night thereafter all of the wireless messages sent out from Sayville by the Telefunken operators were faithfully copied on a phonograph at the Westfield experimental station.



Mr. Charles E. Apgar, Radio Investigator of Westfield, N. J. Who Recorded on Phonograph Cylinders All of "Sayville" Radio Messages for One Month. The Evidence Helped to Close the Station by Uncle Sam.

Each morning the messages were transcribed from the wax cylinders verbatim, and sent at once to Mr. Flynn, either at New York or in Washington, wherever he happened to be on that day. While Mr. Apgar does not wish to commit himself unduly regarding this matter the Editor can truthfully state from what he has stated that it was really his absolutely faithful records of all of the signals sent out from Sayville that caused the United States Government to seize the famous station.

Further, it can be stated that secret messages, in code and otherwise, were thus sent along with regular censored messages, and it may be judged that some of these were incriminating enough in their nature, to cause the Government to act as it did on July 9, when United States Naval officers and operators took full charge of the Sayville Station.

It is interesting to note also that absolute evidence is available in writing in contradiction to many of the statements made by those connected with the Telefunken Co., also known as the Atlantic Communication Co. Of particular interest is the flat statement made by Dr. Karl Georg Frank, general manager of the Atlantic Communication Co., under date of July 18, 1915, when he stated in the public press that—"The statement that Mr. Apgar can record messages sent out by wireless on a phonographic cylinder is hardly worth discussing. That is physically impossible. I have never heard of it being done. If Mr. Apgar has accomplished it he should get his idea patented and perhaps we will buy it."

Interesting, indeed, is the evidence of another nature on the same subject and which is contained in a letter submitted to the Editors of this journal, bearing the above company's letter head, marked and dated Feb. 5, 1914, or about one and a half years previous to the above statement by Dr. Frank. In this letter addressed to Chas. E. Apgar the Atlantic Communication Co., per their Mr. M. Boehme, state that "they shall be pleased to have Mr. Apgar deliver some of his phonograph cylinders, containing wireless message records to them." This Mr. Apgar did on Feb. 9, 1914. This letter is signed by Mr. Boehme himself and also the records delivered are receipted for by Mr. Boehme.

The wireless method of transmitting intelligence is undoubtedly one of the most subtle and flexible known to modern science and it seems that whenever a system is devised to transmit "untappable" messages, then someone will find a way to decipher them.

Mr. Apgar employs an Audion detector in conjunction with the perfected Armstrong circuits whereby it is possible to get wonderful amplification of the signals received and also with but one Audion bulb. Undamped wave stations are picked up very clearly; so well in fact that at his station wireless signals from Nauen, Germany, have often been heard. With the

(*Continued on page* 215.)

The Hammond Radio Controlled Torpedo Boat

Although numerous and multifarious hair-raising inventions are claimed to be in use by foreign governments in the present titanic struggle for the supremacy of Europe, it is doubtful whether there is a more promising invention than that of the young American, John Hays Hammond, Jr.

Most of us have read in the daily papers from time to time of the wonderful wireless control effected by Mr. Hammond's invention, and we present herewith a photo of his latest torpedo boat, "The Natalia." The other photo shows Radio Operator Lee manipulating the wireless key at the Hammond laboratory on shore which controls the emission of wireless waves of various lengths, which when received by the radio antenna on board the automatic torpedo boat serve to make possible complete control of the movements of the boat.

The United States Government has detailed from time to time naval officers at the various trials conducted at the Hammond wireless laboratory at Gloucester, Mass. They have been highly pleased with the performance of Mr. Hammond's truly marvelous radio-mechanical craft, which seems to inherit almost superhuman intelligence. This may be better appreciated if we mention that from the time the boat has started from the pier until it returns from its run, which in some cases has totaled 28 miles, no human being is aboard. Truly uncanny is this meritorious device, and it bids fair to revolutionize modern warfare methods.

The United States Government is seriously considering the purchase of the entire rights to this radio control scheme, as worked out by young Mr. Hammond and his associate scientists and engineers. It would be of inestimable value for the protection of harbors, and as it can carry as much as 4,000 pounds of high explosives and as it also could be directed from shore directly at or toward any hostile warship it is seen that a very powerful weapon is thus placed in the hands of our coast defense corps.

It has been reported of late that the Japanese Government has been negotiating for the exclusive rights to this invention, but undoubtedly the American naval authorities will be wide awake to the far-reaching merits and properties of such a system and we hope that it will take up the matter very shortly, so as to control all rights thereto in the proper manner.

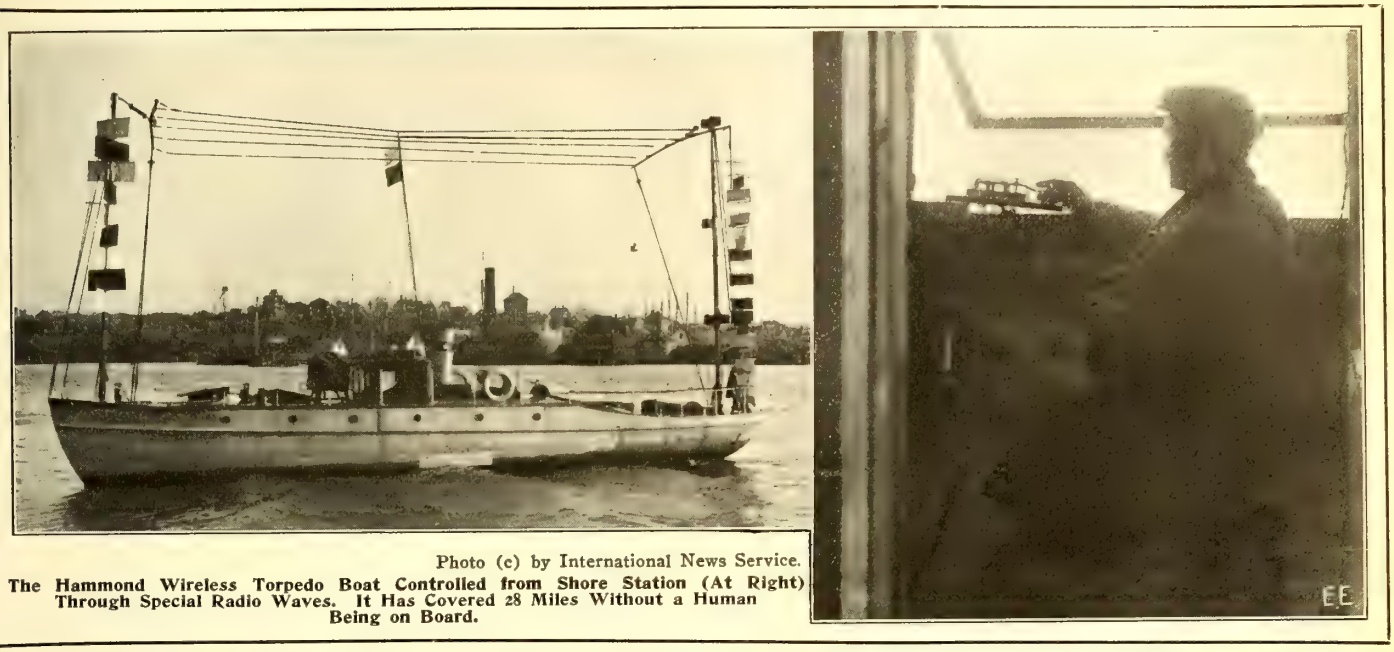


Photo (c) by International News Service.

The Hammond Wireless Torpedo Boat Controlled from Shore Station (At Right) Through Special Radio Waves. It Has Covered 28 Miles Without a Human Being on Board.

ON THE CAUSES OF IONIZATION OF THE ATMOSPHERE.

By J. A. Fleming, M.A., D.SC., F.R.S.

There has been much discussion among radio engineers regarding the possibility of an upper ionized strata of atmosphere which might affect long-distance day and night wireless transmission. After some explanatory remarks Dr. Fleming goes on to say: "Since quartz is not transparent to wave lengths of less than about 1,850 A.U. (Angström wave length units), and since this quartz light will not ionize air, the proof is tolerably complete that no true ultra-violet light ionization of air can take place at low levels in our atmosphere. If there is any such ionization as proved by the electric conductivity, then it can only be due to photo-electric action on dust, ice particles, or to radioactive matter in the sea or soil, or some indirect photo-electric process which yields negative ions.

"On the other hand, solar light, owing to the high temperature of the photosphere, probably does contain rays of short wave length lying within the Schumann (2,000 A.U. to 1,000 A.U.), and Lyman (1,000 A.U. to less) regions. Hence, even although the ionizing potential of oxygen, nitrogen, hydrogen and helium is 9 volts and upward, a true ultra-violet light ionization may take place in the levels of the atmosphere lying perhaps above 10 km. or 20 km. height.

"This, however, does not explain the possibility of a permanently ionized layer. It would merely account for a diurnal layer ionized by day or in the side of the atmosphere facing the sun and disappearing by night. To account for the permanently ionized layer, which it has become the custom, though as the writer thinks somewhat unappropriately, to call the Heaviside layer, it is essential to show cause for the production of ions of one sign only at some high level in the atmosphere. Good reasons have been given for supposing that the photosphere of the sun principally consists of carbon, probably condensed into flakes of soot or granules, and that the temperature, at any rate of its outer portions, is about 6,000 to 7,000 deg. C. Now we know that such incandescent carbon not only sends out ether wave radiation but emits positive and negative electrons, chiefly the latter.

"It is a comparatively easy matter to calculate the velocity and time of passage from the sun to the earth of such ions of various sizes under the action of solar light pressure. We start with the known facts that the Maxwell light pressure in dynes per square centimeter is numerically equal to the light energy in ergs per centimeter cube, and that the best value of the solar constant is 2.1 gram calories per square centimeter per minute, or 1.47×10^6 ergs are imparted per second to a perfectly black surface by normally incident bright sunshine corrected for atmospheric absorption. Hence it follows that the light energy per cubic centimeter is 49×10^{-6} ergs, and the light pressure nearly 5×10^{-6} dynes per square centimeter at the earth's surface. Light intensity at the sun's surface is, however, 46,000 times greater than at the earth's surface, and hence the light pressure at the sun is 2.3 dynes per square centimeter. These figures show that one cubic mile of sunlight at the earth's surface contains light energy equal to 14,710 foot-pounds, and the light pressure is 2.8 pounds per square mile. At the sun's surface the light is 58 tons per square mile and the light energy per cubic mile is 302,300 foot-tons, or energy enough to throw 20 of H. M. S. 'Queen Elizabeth's' 15-inch shells over the top of Mont Blanc.

"According to the most recent mathematical investigations by Prof. A. E. H. Love, who has confirmed results obtained by Prof. H. M. Macdonald, the full discussion of the problem of diffraction of long electric waves round a sphere seems to indicate that with waves 20,000 feet in wave-length diffraction alone will account for the daytime propagation of radio-telegraphic waves over such distances as 3,000 miles. Whether this be so or not, it is perfectly certain that some additional agency is at work in the night time. The onus rests on those who reject the theories built on atmospheric ionization to substitute for them some other valid explanation of the irregularities and generally greater range of night-time signaling.—*The Electrician*, London.

European Applications of Wireless Telephony.

By Frank C. Perkins.

THE accompanying illustrations, Figs. 1 and 2, show the switchboard and electrical apparatus utilized in the wireless telephone system developed at Paris, France, by the Compagnie Générale de Radiotélégraphie, and having a radius of action of about 200 kilometers (about 125 miles).

This French system developed by Colin-Jeance is supplied with current from a dynamo of 500 to 750 volts and from 3 to 4.5 amperes being used. The tension of the arcs in the oscillating circuit varies from 250 to 350 volts, a variable condenser being placed in parallel with the arcs. The current intensity used in the antenna is 3.5 amperes, while the microphone current intensity is .5 amperes, the wave length being 985 meters.

In the accompanying illustration may be seen apparatus of the Reineke wireless telephones for mines, utilized in Germany and in England, the photograph showing the operator speaking from mine cage to engine house.

Engineer T. M. Winstanley Wallis pointed out to the Institution of Mining Engineers that in Germany, as in England, the Government had for some time past urged the installation of telephones in mines; and as the usual troubles in the way of damage to wires occur equally in Germany as elsewhere, Herr Reineke, the inventor of this system, experimented with the view of overcoming these difficulties.

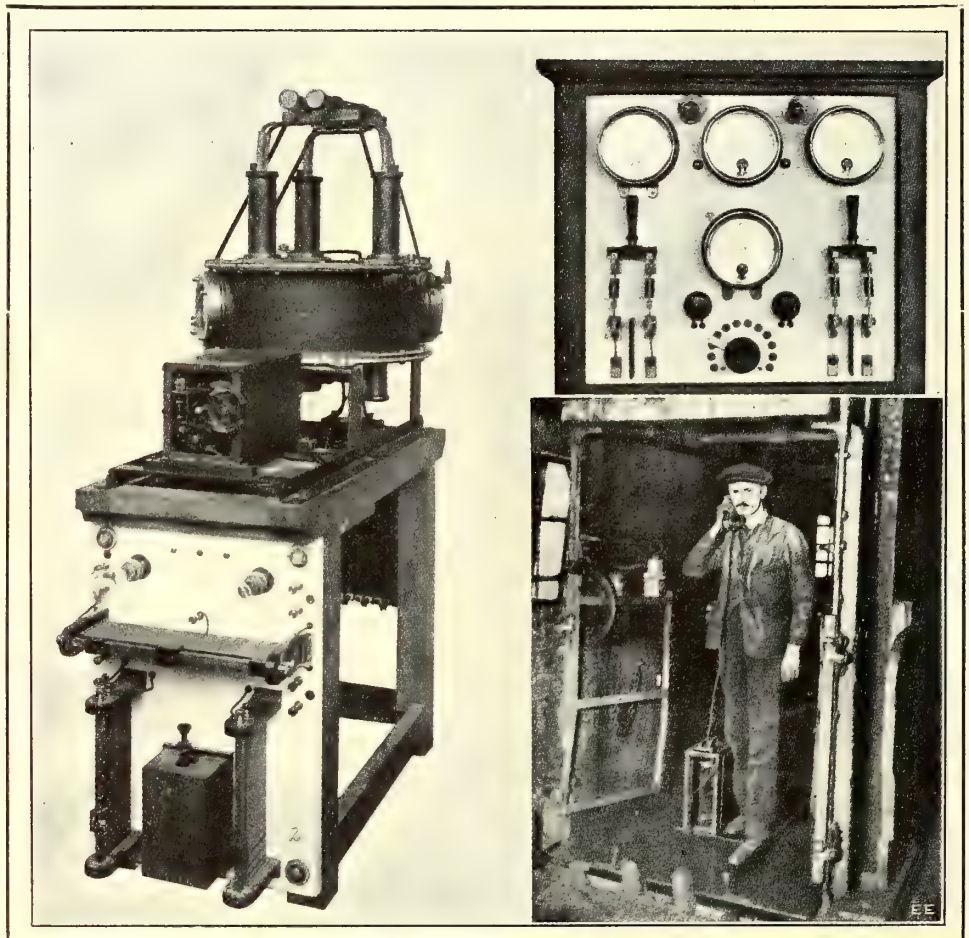
This system is in regular use in the Carolineneglück Pit, Bochum, Westphalia, where no other method of signaling is used and the Wireless Telephone Co., Ltd., of London, has been introducing the system in English mines. It is pointed out that in using the term "wireless" it is advisable to explain that the system is entirely distinct from that commonly used in wireless (or spark) telegraphy, as there are serious objections to such systems that would prevent its general use in mining work.

It may be said that in the wireless telephone the transmission and reception of the speech occur in a similar manner to the ordinary telephone, but there the resemblance ends. Instead of the current from the transmitter being conducted along the wire to the receiver it is converted to high pressure by means of a transformer contained in the telephone case. As the high pressure or secondary winding of the transformer is connected to the ordinary rails or pipes in the pit, it communicates to them a charge of electricity, which spreads over the whole system of rails throughout the pit, and varies with the fluctuations of the primary current in the transmitter circuit of the telephone. It is unnecessary to make any special provision to insulate the rails or pipes, or to connect the adjacent lengths electrically.

It is said that the invention resulted from the discovery that the conditions of distribution of electric charges underground are entirely distinct from the conditions that hold on the surface of the earth, and the working of the system largely depends on this fact. Speech can be received by connecting telephones to the rails or pipes at any point of the system, either by bridging a sufficient length so as to obtain a suitable difference of pressure, or by connecting between the rails and pipes if these exist; or, as is sometimes convenient in the case of portable instruments, by connecting to an antenna consisting of a loose coil of wire, which may be laid on the floor or hung on the timbers.

It may be stated that, as in the ordinary telephone, a bell is used for calling attention, the bell being operated by a specially designed relay. On the button being pressed at the transmitting stations all the telephone bells will ring and all the telephones can receive the message by taking the receiver off the hook, which operation cuts off the bell and connects the receiver in the usual manner. It is possible to tune the relays so that each will respond only to its own particular signal, and thus any one station can be called, but in mining work this is usually not necessary or desirable, and the different stations are called by giving one, two or three rings, as prearranged, while it is always possible, by a special signal, to call all the stations and speak to all simultaneously.

In the Reineke wireless telephone system for mines the current required is furnished by an ordinary battery; in fact, in outward appearance the telephones are exactly similar to an ordinary mining telephone. The portable instrument, which can be carried about and used in any part of the pit to which the rails extend, is contained in a strong metal case, the total weight being about 20 pounds. This telephone can either "ring up" the other stations or be "rung up" by them. A smaller or pocket instrument is also made, which can ring up other stations, but cannot be called by them.



At Left, New French, "Colin-Jeance" Wireless Telephone Apparatus. Top (Right) Switchboard For This Set. Below (Right) New Type of Mine Wireless. Telephone Devised by Herr Reineke, of Germany.

It is pointed out that with the Reineke wireless telephone instrument for mines messages can be sent to or received from any of the fixed telephones, the only difference between it and the heavier portable type being that the other telephones cannot call it by ringing its bell. Thus each official provided with an instrument can give notice of any accident and ask for assistance from any point in the pit. A telephone can be fixed at any convenient position on the surface and connected to the headgear, if of iron, or to the winding rope or pipes which go down the shaft.

It is maintained that this telephone can speak to any of the telephones underground if necessary, but it is usually found more convenient to arrange for it to speak to the station at the pit bottom only and for this station in turn to speak to the underground telephones. In metalliferous mines, where a number of different levels run from the shaft, communication can be established from one level to another as required, the presence of the ore bodies not affecting the speaking in any way.

A most important application of the system is that of speaking from the moving cage to the winding engine house, and for the latter position the inventor has designed an ingenious method of operation. The telephone is mounted on a standard fixed close to the engineman's ear. On receiving a call he has only to put his ear to the receiver and a slight pressure is sufficient to switch in the telephone and enable him

to communicate with the cage without removing his hands from the levers.

The advantages of this wireless mining telephone are many, and it is absolutely safe, there being no possibility under any conditions of producing a spark.

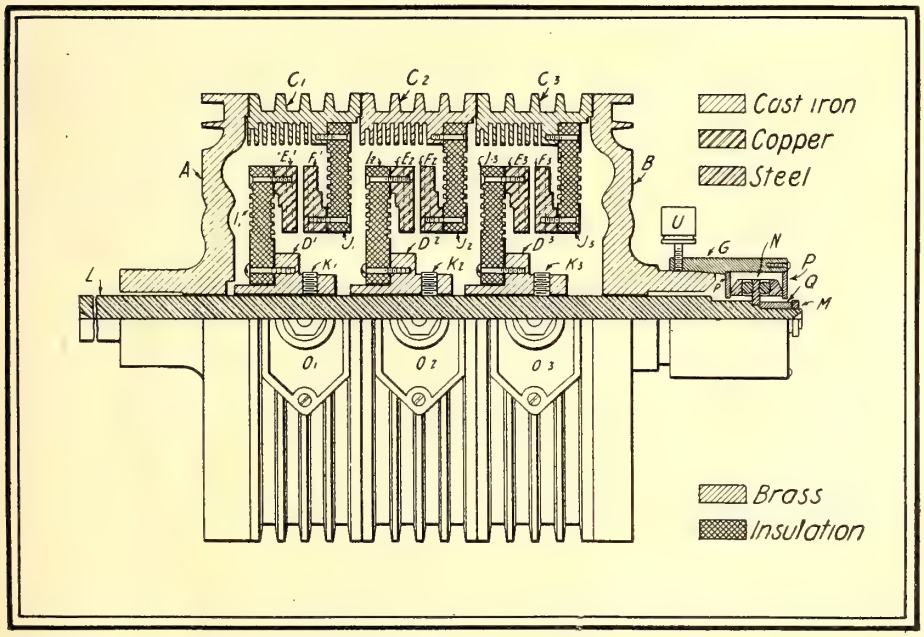
The inventor's claim that it provides complete security of communication, as there are no connecting wires to be interrupted and it can be easily removed from one place to another if required, while it cannot be affected by or affect other electric circuits in its neighborhood, whether these are direct or alternating currents conveying power or used for signaling, nor is it interfered with by ordinary wireless telegraph signals.

It is held that the opinion of the Continental experts who have exhaustively tested the telephone has been universally favorable and indicate that in this system a means of underground communication has been provided which is entirely free from any of the objections that have hitherto prevented the general use of telephones in mines.

THE HYTONE SPARK GAP.

The average experimenter is not very familiar with the working parts and operation of the hytone gap, about which much has been said. This new gap is of the rotary quenched type, several units being used in series, the number depending on the power rating of the set.

The construction is shown in figure which is a cross-section. A small motor (1-3 H.P.) is directly connected to the shaft "L," which rotates inside of the case housing "A C B." Bakelite discs "I" are screwed at their center to hubs "D" and at the outside to copper rings "E." Opposite each copper ring "E" are two copper half rings "F," supported on Bakelite pieces "J." The gaps are connected in series, and terminals are brought out from each through insulating bushings. A double thrust ball bearing "N" is mounted in a nut "G," so that the distance between the rotary and stationary electrodes may be adjusted. These gaps are made very accurately and very skilled mechanics are needed in building this device, as the distance between the rotary and stationary plates is only .003 inch (.075 mm.). The sparking surfaces are made of copper and both rotary and stationary plates are milled with 36 radial slots, so that when rotated at 1,000 R.P.M. the tone corresponds to that of a 540 cycle alternator. It is necessary that the width of the sparking segments be so proportioned that the sparks occur during not more than one-half of the total time, as otherwise the receiver telephone diaphragm is retarded on its excursion away from the magnet, thereby resulting in a decreased sound intensity. A great many experiments had to be made before such results were obtained.



The Highly Efficient Rotary-Quenched Spark Gap (Hy-Tone) Produces 500 Cycle Tone Spark From 60 Cycles A. C. Etc.

WIRELESS TELEPHONY DEVELOPMENTS.

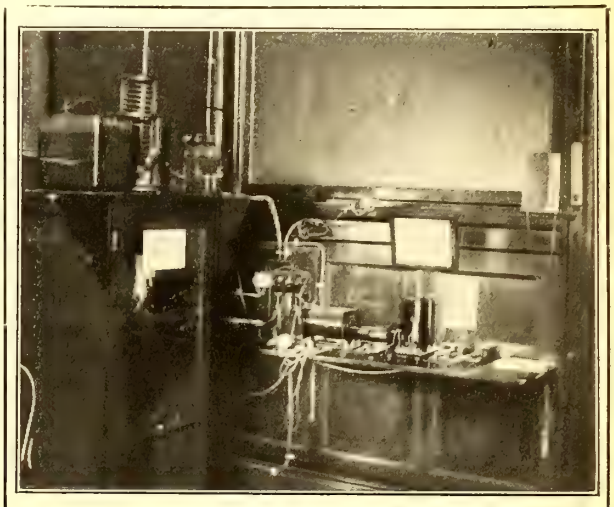
For several years the problem of wireless telephony has been handicapped by the need of a microphone which could handle considerable currents, and thus little progress was made in this direction until investigators began to get away from recognized paths. Various systems have been tried from time to time, such as the T. Y. K. system of Torikato, the Janke system with the Poulsen arc, that of Ditcham, and that due to Colin and Jeance and others, but without any very great success. The new highly rarefied vacuum tube, however, has put a fresh weapon at the disposal of the investigator which promises to revolutionize present methods. Certainly, in one direction or another advances are being made very rapidly at the present time, and something in the nature of a revolution seems to be coming about. The reaction vacuum tube is now being applied to wireless telephony by the Marconi Co. The tube is partly used for the production of continuous oscillations and partly for the magnification of the signals that are received. One of the most interesting points is the fact that extremely small aerial currents, such as 0.2 ampere, are sufficient to enable speech to be transmitted a distance of 70 km. Telephone sets on this principle, delivering 0.6 ampere to the aerial, are now sufficiently commercial to be guaranteed for a distance of 50 km. between ships at sea, and thus radio telephony is coming into its own.

WIRELESS AIDS TELEPHONE SYSTEM.

Using the wireless in a business that is built entirely upon wires seems an anomaly.

But that is what the Pittsburgh & Allegheny Telephone Co. is doing. The telephone business, of course, depends upon wires. Without wires the telephone is useless, for invention has not yet evolved the wireless telephone in perfect form.

As a valuable supplement to the wire business, however, the wireless is a vital factor. The truth of this is attested by the fact that the Pittsburgh & Allegheny Telephone Co. has developed a wireless organization as a distinct department of its business. The main station is in Pittsburgh. Eight branch stations are established at points in western Pennsylvania, eastern and central Ohio and parts of West Virginia—throughout the territory in which the company operates its telephone system. Trained operators, working the company's secret code, keep in daily touch with the big station in the Miller building in Fernando street, Pittsburgh. The most distant station in the organization is at Erie, Pa., a distance of nearly 200 miles.



Wireless Set Used to Extend Operation and Usefulness of Regular Telephone System.

The need for the wireless became apparent when a storm of wind and sleet last winter threw down a great number of poles.

Now the company is ready. If another storm does the damage that was inflicted last winter the company can get into communication at once and continuously with every part of its system. The whole situation could be handled and directed right in the Pittsburgh office and the innumerable delays of last winter obviated.

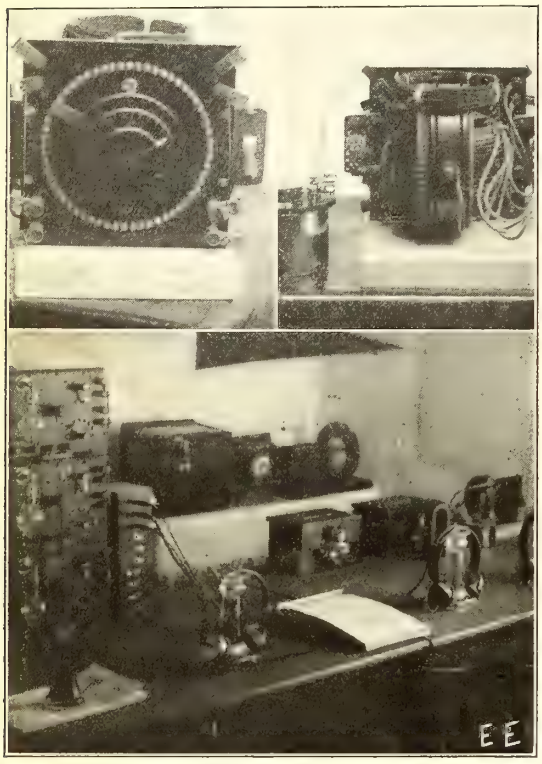
Practically all the apparatus in the Pittsburgh station was made in the company's shops in the Miller building. All the transmitting apparatus except the sending key is enclosed in the soundproof case. The receiving apparatus is placed on the shelf. The aerial is 170 feet long and 100 feet high, and is composed of four vertical and four horizontal No. 10 copper wires insulated with high-voltage insulators. The ground wire is composed of 125,000 circular mils area stranded copper rubber-coated cable.

In connection with their professional interest in wireless as an aid to the telephone business, Messrs. Muhlheizler and Weaver have encouraged the large number of young amateur wireless operators who have set up stations in western Pennsylvania. Largely through their efforts the Radio Society of Western Pennsylvania was organized.

Some Remarkable Results With Audion Amplifiers

By John A. Gardner and E. R. Isaak

I AM presenting herewith photos and drawings of some of our circuits, and will try to give a partial description of same. This covers our radio station at Eureka, S. D.



Views of Specially Arranged Loose Coupler and Complete Audion Receiving Set Used by Messrs. Gardner & Isaak Very Successfully.

As can be seen from the photo, our receiving set is of somewhat elaborate design. It consists briefly of tuning coil and rotary condensers, two audion detectors connected in cascade so as to amplify the signals, and three one-step amplifiers to amplify the signals as they come from the detectors. This arrangement makes use of five audion bulbs and their circuits for amplifying the signals. The amplification is so great that different parts of the circuits set up siren or whistling effects which effectually put a stop to the operation of the set or further amplification. In this article I will outline the special circuits we had to devise to make possible the efficient working of the many amplification units in one set, without being hampered by siren effects.

In Fig. 1 is shown the circuits for cascade connection of two audion detectors using one 6-volt storage battery to light both filaments. This is different from recently published circuits of the cascade connection using two batteries for heating the filaments, and it will be noticed that the 35-volt battery is shifted to a different part of the circuit in the first detector from where it would be if they were not connected in cascade. Tests seemed to indicate that this circuit not only amplified as much as the one using separate batteries for heating the filament but amplified quite perceptibly more.

This circuit may be used for receiving from the continuous wave stations by slightly changing the adjustment of the heating current and 35-volt battery current of the first detector. We use the magnet shown in the cut for helping to attain this adjustment, and also with the bulb we are using in the first detector now the magnet seems to increase the strength of signals from the spark stations. In use it is set in the position shown in the illustration. For the impedance coil shown we are using the secondary of a ½-inch spark coil. This is perhaps not the best that could be designed, but it works well. The iron core is, of course, left in place.

Fig. 2 shows the circuits of the plug box and amplifier. The plug box allows either one, two or three head sets to be connected to the third-step amplifier, the second-step or the first-step, and one head set can be plugged in on the second detector of the cascade set. This is invaluable for testing at any time the relative amount of amplification of the different amplifying units. The plug box is so wired that the head sets are connected in series. The weakening of the signals from plugging in two extra head sets is scarcely perceptible. This is owing to the extremely high resistance of the vacuum space in the amplifier bulbs. The additional resistance of one or two 4,000-ohm head sets makes little difference.

The first-step amplifier differs from the second and third only in the design of the transformer. It seems very necessary that the secondary of the transformer of potential circuit be not connected direct between the grid of the audion or amplifier bulb and the filament, but that a very small condenser, usually bridged by a very high resistance *made of slate or a pencil mark* be interposed in the circuit. The purpose of the high resistance is to prevent the bulb becoming paralyzed by static or strong signals, and should not be any lower than is absolutely necessary to accomplish this effect. The audion detectors seem to have only the condenser, but it is likely there is enough leakage through the wood of the containing box to accomplish this effect. In the second and third-step amplifier circuits shown the capacity between the two transformer windings is sufficient, and the illustration shows the adjustable high resistance made of slate that we are using.

As shown, the cascade-connected detectors are operated from one 6-volt storage battery, the first and second-step amplifiers from another, and the third-step from still another. This combination seems to be the only one we could work out that would give the maximum amount of amplification and operate without siren effects.

Fig. 3 shows views and part of circuits of our tuning coil. We consider this coil to be superior to any we have ever seen described. It will cover any wave length up to 16,000 meters or more without perceptible loss of efficiency from "dead ends" or from the volume of wire necessary to be used in a coil to cover the longer ranges, giving very close adjustment over the entire range. Every turn of the primary is inductively connected to every turn of the secondary, which is not the case where

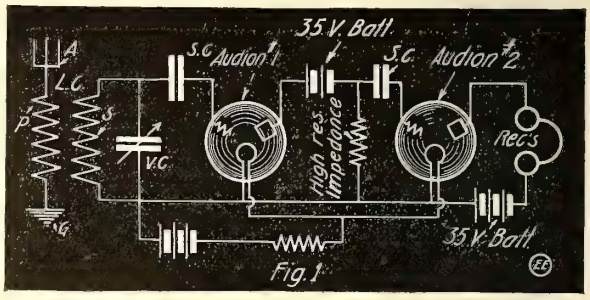


Fig. 1. Double Audion "Detector" Hook-Up.

tuning coil and loading coils are separate units, and the coupling of the entire tuning coil can be varied to about zero by simply turning a knob. The additional turns of wire up to the entire capacity can be added to either primary or secondary, or both, the windings being inductively connected in the most efficient manner, a flexibility not possible if tuning and loading coils are made in two or more separate units. They are arranged to be thrown in or out of the circuit by throwing the switch or telephone switchboard key shown in diagram, which dead-ends both ends of same when throwing them out of circuit.

It is a well-known fact that the audion is a potentially operated device, and that with

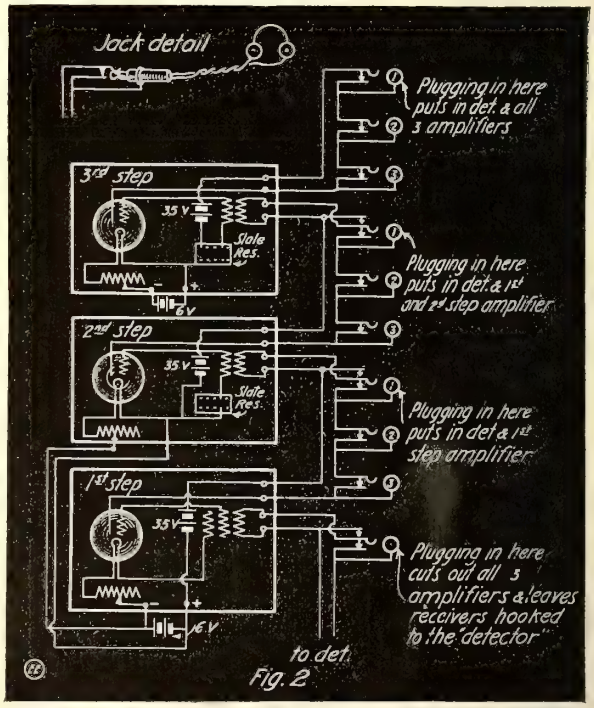


Fig. 2. Diagram of 3 Audion "Amplifier" Bulbs and 'Phone Jack Circuits.

a given tuning coil the signals are louder when the same wave length is tuned to in the secondary circuit, by using more wire and less condenser, than when using less wire and more condenser.

This effect can be carried out to the point where an ordinary variable condenser is adjusted to nearly zero and more wire is used in the secondary to get the correct wave length with a very perceptible gain

in the strength of signals. The flexibility of this tuning coil allows this to be done, and hence the great superiority of this design for a tuner to be operated in connection with an audion. Arlington tunes in here with but 29 turns of the original primary winding, while for the secondary we use zero condenser and *five times* the original secondary winding.

Our aerial is "T" shaped, and each half

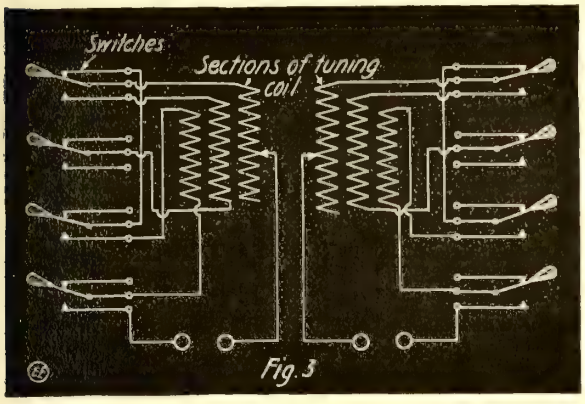


Fig. 3. Special Hook-Up of Loose-Coupler Windings to Prevent "Dead-Ends."

is about 500 feet long and averages 75 or 80 feet high.

We can hear Arlington at our station, Aberdeen, S. D., very plainly every day at this time of year unless there are unusual conditions, and are now doing most of our receiving by day. We can also hear Springfield, Ill., send out the time nearly every day at noon, and usually it comes in quite loud. We are unable to hear Key West, or San Diego or Mare Island on the Pacific Coast at this time of year, but we very often heard them in the daytime when they sent out the time during the winter.

The photo of tuning coil is not very good and does not show it as we would like. Also there will be seen a coil lying on top of this coil or tuner, and a condenser forming a separate circuit that has nothing to do with the tuning coil proper and should have been left out of the picture. When the static is extremely severe we couple the tuning coil so loosely that no signals at all come through, then we tune in this extra coil and condenser to the wave length, and by tipping it slightly to one side it forms the coupling between the primary and secondary of the tuning coil, enabling us sometimes to read messages that otherwise are drowned out by static.

[*Editor's Note.*—A resistance of 9,000 ohms has been found very good for the iron wire core impedance coil linking up the two audion detectors in diagram Fig. 1.]

WHY SAYVILLE RADIO STATION WAS CLOSED.

(*Continued from page* 210.)

apparatus here shown working at full activity and when hooked up with his super-sensitive, special type, microphonic amplifier in conjunction with the Armstrong Audion circuits the signals are so loud that one can hardly stay in the room while they are "coming in" through the loud talker horn shown at the right of the picture. When the wireless room windows are open signals have been heard 600 to 700 feet away very clearly innumerable times. Mr. Apgar is certainly to be congratulated on his excellent work. Thus the experimenter comes into his own.

OUR SUPPLEMENT

THE supplement accompanying this issue of the *Electrical Experimenter* shows the working drawings for the construction of an improved type wireless loose coupler, capable of tuning in messages up to 4,000 meters wave length, when used with an aerial at least 80 to 100 feet long, comprising four to six strands, spaced three feet apart and elevated 75 to 80 feet above the ground. With larger aerials, of course, much greater wave length ranges are available with this instrument.

The drawings explain themselves and we will cover the principal points involved in making the coupler briefly.

The primary and secondary coils are provided with tuning switches instead of sliders, in accordance with the best practise now followed in building such apparatus, and thus positive contact is always assured throughout these circuits. Each winding consists of one layer of wire, wound on evenly, and the taps for the various switch points are provided for while winding the coils by simply leaving a loop in the wire and twisting this loop so that it will hold itself in place. The taps are evenly divided as regards the total turns on the coils with respect to the secondary winding. In the primary coil one blade of the switch has its points connected up to successive individual turns; while the second blade of the switch controls grouped units of turns, which units are equal in number of turns.

The construction will be grasped by looking at the drawings closely; full detailed figures are not suggested for the reason that most everyone will make up the cabinet to suit himself from materials at hand. This coupler may be made larger or smaller, as preferred.

The primary interpolating switch is simply constructed and the smaller knob on same is joined rigidly to a movable center shaft which is insulated from an outside hollow shaft, and in this way two circuits are carried up through the central "combination" switch post.

A loading coil is suggested to be used with this coupler, although it is not absolutely necessary, excepting for tuning in wave lengths above 1,500 meters. This is shown in the drawing herewith, as are also details of wood or fiber form, on which to wind it.

There are eight tap leads brought out from the loading coil and equally divided, as perceived. This includes the starting and finishing leads from the coil; the wire is simply looped out successively through one of the slots as the coil is wound, in order to provide for the eight tap leads, which connect to the loading coil switch points on the hard rubber switchboard front of the primary cabinet of the coupler. The loading coil is made very thin, as will be noted, so as to give it the well known "pancake" coil effect, which is very desirable in wireless circuits; a thick coil of this type is not recommended.

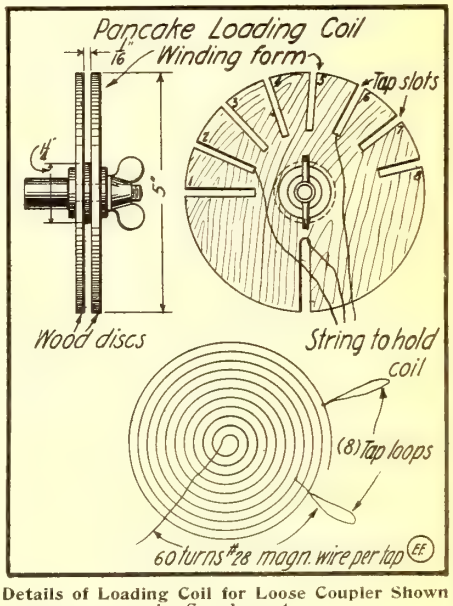
Also in winding such a coil as this for wireless circuits care should be taken to "cross over" the turns or "stagger" them as much as possible and not to keep them even, as in winding magnet coils. This is done to minimize the effect of distributed capacity between turns.

A word of caution to those making such instruments as this with tap leads brought out along the coils should be noted, and the point in mind is this:

Such tap leads should in every case be short-circuited at their twisting point where they leave the coil, so that when a number of sections of such a winding are in use the current will not have to pass through one section out and around through such a tap lead or loop, back to the next section. This would greatly reduce the efficiency of the coil. Therefore the wire lead should have its insulation scraped off about ¼ inch from the winding layer proper, and preferably this point on the lead should be soldered. For those making use of Audion or Fleming valve detectors, which are potentially operated, it is best to wind the secondary of the coupler with much finer wire, say No. 30 or 32 B. & S. gauge. Some writers recommend as fine as No. 36 wire for such detectors, but it is doubtful if the damping and resistance (which are directly related) do not reduce the efficiency of the circuits of the coupler, and that the gain created by using a greater number of turns of fine wire to increase the secondary coupler potential is not off-set by the high "damping" value of the circuit. This can be experimented with, of course, by the operator making use of such apparatus.

Regarding the secondary, spring contacts are arranged inside the secondary form and which make contact with the two slider rods, upon which the secondary moves back and forth, and in this way current is carried in to and out of the secondary winding.

The arrangement shown for the secondary switch will be found very efficient and handy indeed; also this one switch knob will serve two purposes, viz., to adjust the inductance value of the secondary, as well as to vary the coupling or distance between the primary and secondary windings, by moving the secondary in to and out of the primary in the usual way.



Details of Loading Coil for Loose Coupler Shown in Supplement.

INTERESTING NEW INVENTION

A door-knob connected with an electric lamp that may be switched on by pressing a button has been patented by a New York inventor. The invention is expected to help materially in the sometimes difficult process of finding the keyhole after dark. The door-knob is illuminated. The same principle is applied to the doors and dials of safes.

AERIAL WIND STRESS PROTECTION.

Considerable trouble is encountered by amateurs utilizing trees for their aerial supports, by the breaking of the aerial wires, when the wind blows.



Balance "Strain" Weight for Tree Aerials.

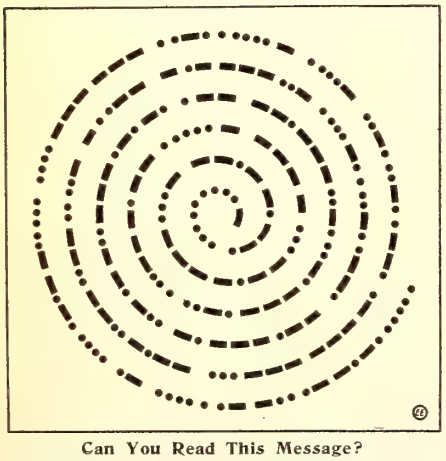
The common method of overcoming this is to allow considerable slack in the wires, which decreases the efficiency and also gives the aerial a saggy appearance.

However, in the illustration herewith given is shown an easier way of eliminating this disadvantage, which will keep the aerial tight at all times, regardless of how strongly the wind blows or how much the tree sways.

A pulley is hung loosely on a limb at the top of the tree and a small rope run through it to the aerial spreader, the other end of the rope being fastened to a post on the ground, 20 or 25 feet from the base of the tree.

A 50-pound weight (a railroad iron is suitable) is attached to the rope, as described, and perfect protection is now insured against snapping wires. Contributed by ARTHUR DARLING.

TRY THIS ON YOUR VICTROLA



Can You Read This Message?

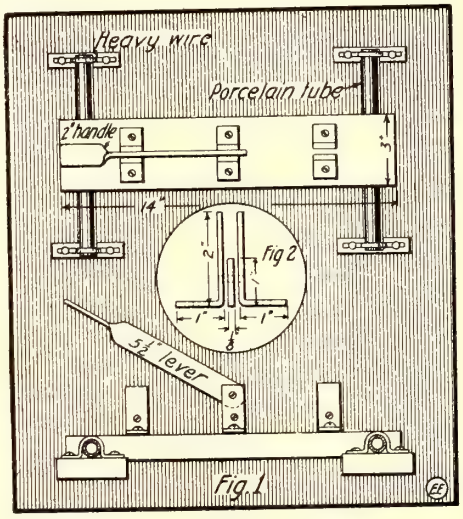
HOME-MADE LIGHTNING SWITCH.

The high price of lightning switches prevents many wireless amateurs from protecting their homes or wireless stations properly. The one here described is cheap, well-insulated and capable of carrying 100 amperes.

The switch base is made of well-seasoned wood, 14x3x1½ inches. The jaws and switch lever are made of strip brass or copper, 1 inch wide and ⅛ inch thick. The lever is 8 inches long, constructed as shown in Fig. 1. An ⅛-inch hole is drilled ½ inch from the end, while the other end is twisted by placing in a vise, so as to make a handle 2 inches long. The jaws are built as shown in Fig. 2, standing 2 inches high with 1-inch flanges. A piece of brass 1 inch square and ⅛ inch thick is placed between the jaws to properly space them, and also to stop the lever in the proper position. An ⅛-inch hole is now drilled through the jaws and a piece of strip copper or brass, ½ inch from the bottom, and a rivet inserted and upset.

The jaw holding the lever is made similar to the above, with the exception that the hole is drilled ½ inch from the top instead of the bottom; no piece of strip copper being inserted between the jaws, the switch lever taking its place.

To insulate the switch properly two 6-inch porcelain tubes are used. Holes are bored a little larger than the diameter of the tubes, 1 inch from the ends of the base, and the tubes are slipped through and wedged. Four standards are now made upon which the ends of the tubes are clamped with heavy copper wire and the



Home-Made Lightning Switch.

standards are now screwed to the side of the house or shop, convenient to the lead-in wire. If the switch is not protected normally from the weather, it should be covered with a box. Contributed by ARTHUR DARLING.

SOMERVILLE, MASS., BOY RADIO OPERATOR.

The management of the Hotel Thorwald, Gloucester, is much pleased with the work of one of its employes, Willis Herbert Farnum, who has installed a wireless station there which allows the guests the privilege of receiving wireless messages of all the latest news, including sports, war news, movements of vessels, weather reports and the correct time. The station is in touch with stations as far north as Halifax, N. S., and as far south as Key West, Fla. Mr. Farnum has been an interested student of wireless telegraphy for several years, and is now gaining considerable fame as an expert operator.

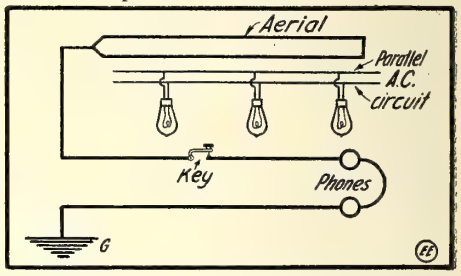
NAVY ENLARGING WIRELESS STATION AT NEW ORLEANS.

Work on enlarging the naval radio station at New Orleans and installing more powerful instruments is nearing completion.

As rebuilt the New Orleans station will be the second largest of those owned by the Government. It will have a power of 30 kilowatts against the five of the original plant, and will be used principally as a relay for messages between the Atlantic and Pacific Coast stations and, when necessary, for communication with Panama.

A BATTERYLESS CODE TEACHER.

Having an aerial parallel to the A. C. electric light wires, I hear a steady buzz, when the phones are connected in series



Code Learning by Induction Current from 110 Volt A. C. Circuit.

with the aerial and ground, and have used it to advantage, as shown in the diagram, to practise the code. No buzzers or batteries are needed.

Contributed by R. SHANAHAN.

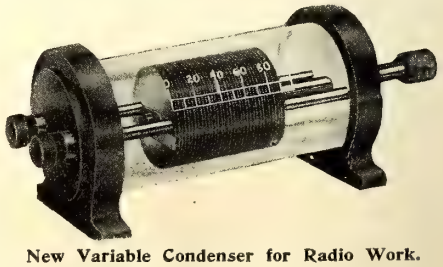
NEW HIGH POWER GOVERNMENT RADIO.

The Navy Department is planning to construct a new high power radio station on Puget Sound, probably at Keyport, near Bremerton, Wash. The plant will be one of the most modern stations ever built and will have towers 400 feet high. It is also reported that another wireless station will be erected on the Vopper River Flats at Cordova, Alaska.

A NEW RADIO VARIABLE CONDENSER.

A new variable condenser, which works different from any of the other condensers on the market, has been invented by Eugene Turney, the originator of the Crystaloi detector.

The photograph herewith illustrates the complete condenser, which consists virtually of 35 circular aluminum plates, supported on two rods, one of which is half insulated, and which are enclosed in a glass cylinder. On each side of the plate is an insulated washer, and the plates are alternately arranged on the rods so that when they are moved by means of a small handle, as shown, one plate will make contact with one rod, while its adjoining plate makes contact with the other rod, and so on. In this way the plates are varied just by pulling them in or out and consequently vary-



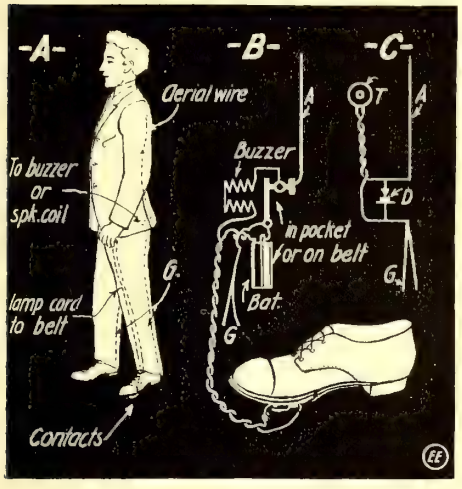
New Variable Condenser for Radio Work.

ing the capacity. When they are fully in, the capacity is at zero; as the plates are not then connected to the metallic rods, since one of them is half insulated, therefore that portion is at the end.

With such a condenser short circuits are eliminated, which is the main difficulty in the present rotary variable condenser. Two types of such condenser are now being marketed, one of 35 and another of 50 plates.

WIRELESS AND MIND READING.

MANY acts before the public profess to transmit mind waves by mental telepathy, but whether they do or not is always the debatable question. However, for the parlor entertainer it is a very simple manner to carry out such an act with the aid of a miniature wireless outfit carried on the person. For ordinary distances up to 50 or 75 feet and more, a buzzer of ordinary type will serve as the transmitter, excited by a flashlight battery, and both carried in the pockets or on a belt. Down the leg is run a 2-conductor cable of lamp cord connecting to the battery and buzzer as seen at Figs. A and B. For aerial and ground a piece of lamp cord or high tension cable is carried up the back under the coat and down the pant leg as shown. No danger whatever is present from accidental shock, etc., with a buzzer, but for the most reliable work in the largest auditorium, a small spark coil of ⅛ to ¼ inch spark capacity, should be used. A ¼ inch coil can be run, for instance on 1 or 2 dry cells of flashlight battery, so as to keep the power down. In this case, extra heavy high tension cable must be used for aerial and ground. The coil or

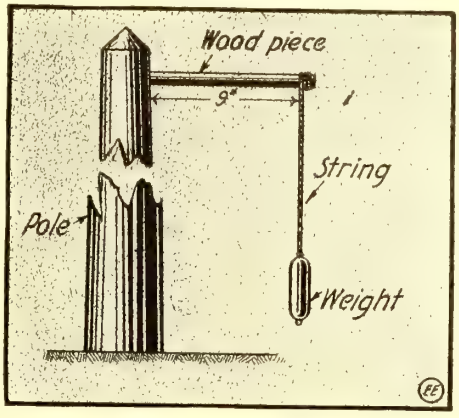


Wireless for Fake Mind Reading Act.

buzzer circuit is closed thru contact pieces of brass secured under the sole of the shoe. The receptor comprises a detector (preferably a Radioson or other constantly adjusted type), and a wireless receiver T, (1,000 ohms resistance is best). The regular telegraph code is used and by learning this, both parties can work together nicely. It works out like this: A common act is that where a gentleman goes about the auditorium or parlor asking each person the name of the song they desired played by his accomplice on the stage, who is usually a lady, who can easily cover over the telephone receiver with her hair without exciting suspicion. Now most "sharpers" who see such acts at once deduce that all of the gentleman's queries are keyed by the way in which he expresses each request of his accomplice or rather by the juxtaposition of certain words in the query. This is a common scheme long used for the purpose, but to-day something better is required in high grade entertainments. Hence with this wireless scheme, the speaker has them all guessing because each request can be stated in exactly the same way and tone of voice. For instance, "Play this gentleman's selection," etc., and this same line can be used right along, changing it to suit when referring to a lady, of course. It is usual to number the songs for such an act and then the "wireless actor" simply has to transmit the number to his assistant on the stage. For example, if "Annie Laurie" was No. 17 on the *made-up list,* then 1 and 7 in code are transmitted via radio, 1 being equivalent to dot, dash, dash, dot, and 7 to dash, dash, dot, dot. By knowing the code, the name of a song whispered to the gentleman can be transmitted if perchance it didn't happen to be on the numbered schedule. A quenched spark gap should be used on the spark coil to eliminate the noise, and the buzzer or the coil must be specially built or well muffled to prevent the vibrator hum being heard by the auditors.—H. W. S.

HOW TO PLUMB AN AERIAL MAST.

To plumb a mast fasten to the top of it a piece of wood projecting out about 9 inches. Suspend to this a window iron or other weight by means of a string, bringing the



Plumbing an Aerial Mast.

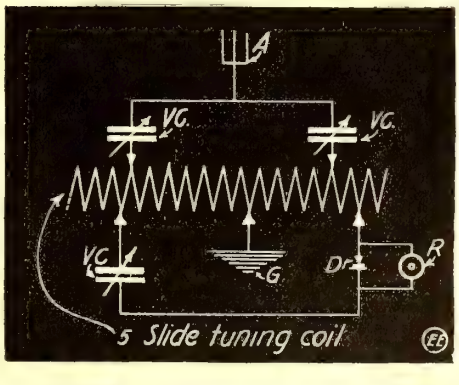
weight near the ground. Now adjust the pole on parallel with the weighted string, allowing 9 inches between them, thus creating a perpendicular pole.

Contributed by
WALTER FRANSEEN.

ELIMINATION OF INDUCTANCE DISTURBANCES.

A clever method has been suggested and found to be successful in practise for the elimination of sounds in wireless telephone receivers produced by neighboring power lines. This method is depicted in the drawing, which is self-explanatory. A five-slide tuning coil, three adjustable condensers, detector and telephone receivers are necessary. Probably a three-slide tuning coil will fulfil the purpose if the end connections on the coil are used in place of two of the sliders However, the five sliders give a wide range of adjustability which allows of some wonderful tuning possibilities, including the tuning out of unwanted radio signals. It may be found somewhat difficult at first to manipulate the five sliders, but a little practise will soon familiarize the operator with the best methods to pursue.

Contributed by F. KANÆ.



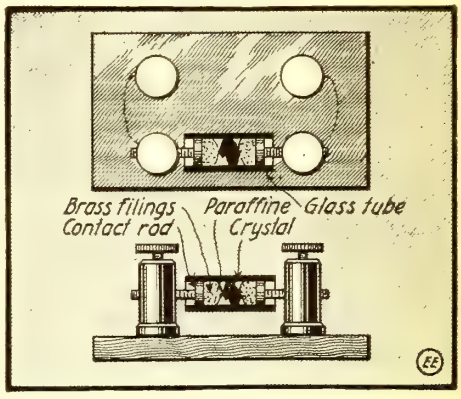
A Five-Slide Tuning Coil Proves Highly Selective.

A "PERMANENT" WIRELESS DETECTOR.

No doubt many an amateur has gazed at the advertisements of "Permanent" detectors and wished he possessed one of these *wonders* that can neither be knocked out, burned out nor kicked out, and that eclipses all others in sensitiveness. But usually the price is a little "steep."

The detector I shall describe *is* permanent, and it takes a stronger-than-usual current to burn it out. The sensitiveness all depends upon the construction.

Select a piece of thick annealed glass tubing (such as water gauge tube) with a bore of ¼ inch. The tube should be 1 inch long. Get a piece of galena that will closely fit into the tube. This galena must be *sensitive,* and with as many sensitive spots as possible. I remember breaking up several ounces of galena before I found the piece I wanted. Slide this crystal into the middle of the tube and seal it in place by letting a little red sealing wax run in along the inside of the tube from both ends. A candle is very good for this operation. But be sure that the crystal is *not* covered up. There should be at least ⅛ inch of open space on the crystal at each end, and these two spots *must* be sensitive, which means a nice place for trouble if they are not. Take a pin and cut off the wax evenly all the way around the inside of the tube (see drawing).



Permanent Detector Easily Made.

Next, some metal (brass) filings are filled in at each end, making contact with the crystal, and the contact rods are pushed in after the filings. These contact rods are common switch points with the heads filed down to fit the tube. These rods fit into two binding posts as per drawing, which completes the working parts. The whole is then mounted on a base with two other binding posts for connecting to the circuit.

It will take a little time and patience to test out the crystals and assemble the detector, but once in operation it *stays* in operation. Drop it on the floor, sling it around, shake it! So long as you don't hit the tube with a hammer the detector remains as good as ever.

If no suitable galena can be found silicon can be used.

Contributed by
EARL H. SWANSON.

HOW-TO-MAKE-IT DEPARTMENT

This department will award the following monthly prices: FIRST PRIZE $3.00; SECOND PRIZE $2.00; THIRD PRIZE, $1.00.
The idea of this department is to accomplish new things with old apparatus or old material, and for the most useful, practical and original idea submitted to the Editors of this department, a monthly series of prizes will be awarded. For the best ideas submitted a prize of $3.00 will be given; for the second best idea a $2.00 prize, and for the third best a prize of $1.00. The article need not be very elaborate, and rough sketches are sufficient. We will make the mechanical drawings.

FIRST PRIZE $3.00.

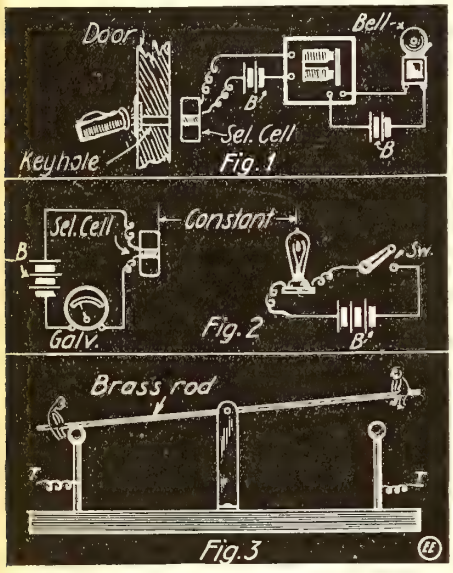
A FEW ELECTRICAL KINKS.

Two Uses of a Selenium Cell.

To make a selenium cell burglar alarm: Place the cell (Fig. 1) inside the keyhole of door or safe and connect with bell and battery, using a relay. When burglar flashes lamp the cell closes relay, which rings bell in local circuit.

Using a selenium cell to test candle power of lamps: Connect as shown in Fig. 2, using same voltage each time. Use a galvanometer, which can have its scale specially calibrated. The meter may be calibrated by using lamps of different known candle power.

A novel static see-saw is illustrated herewith and can be worked on any Whimshurst machine. Connect the two chains T T to



Some Handy Electrical Kinks.

the poles of the machine and start the see-saw. The action is simple. The one pole attracts the brass rod and then repels it, the brass rod being charged with electricity. This is distributed all over the surface and is attracted by the other ball, and so on. Small and very light cardboard figures may be mounted on the ends of the rod. Brass balls can be tried on the rod, placing them opposite the fixed balls.

Contributed by EARL DIETRICH.

HOW TO DO SOLDERING.

Although soldering is not under the head of electricity, it is so closely allied to electrical work, not only in practical but experimental and wireless work, that any information on it ought to be welcomed by readers of this magazine who still twist their wire tightly and expect to get a *perfect,* low resistance joint.

To heat the soldering iron you will require a stove or fire, but the best and most convenient method is to use a Bunsen gas burner. A wire support for the iron should be made as suggested in the sketch.

The "dip" solution may be made by dissolving zinc in muriatic acid until it is completely "killed" or ceases to bubble, and then diluting the acid with about five times its volume of clear water. This is poured in a porcelain or glass container and is kept handy near the burner for convenience.

The flux should by all means be non-corrosive; tallow is as good a thing as can be obtained, although hard to work with. There are many preparations on the market that are good (as Solderall, No-corrode, etc.), and it is very much easier and cheaper to buy a small can of some reliable make. By all means use soft solder; wire solder fills every demand.



Essentials of a Soldering Outnt.

Light the burner and adjust it till it gives a clear, blue flame, and lay the iron on the support so it is in the upper or hottest part of the flame. Meanwhile clean the parts to be soldered and give them a thin coat of flux. *Remember, metals MUST be bright and clean, else the solder will not "flow."*

When the iron is hot enough (not red hot) dip it for an instant into the "dip" solution, then touch it to the solder and give it a good coat. This is called *tinning.* The parts should now be tinned by passing the iron over them, then press together and rub iron on top, resulting in an electrically perfect joint. Be sure the solder flows evenly and smoothly through the joint.

The iron is hot enough when green flames are seen around its edge, and it may be necessary to file a clean surface on it if it gets red hot, as this burns the solder off. In closing, I repeat: Always keep the iron well tinned and the parts well cleaned, and success will invariably follow.

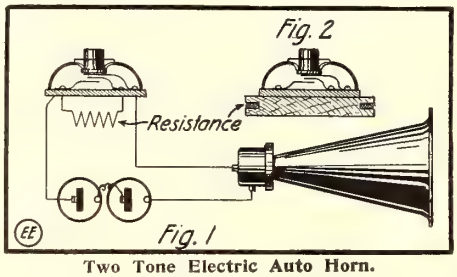
Contributed by THOMAS W. BENSON.

SECOND PRIZE $2.00.

A DOUBLE-TONE AUTO-HORN.

By inserting a little resistance in series with an automobile horn or other electric signal the tone may be lowered more or less, depending upon the amount of resistance set into the circuit.

Oftentimes it is very undesirable to blow an auto horn while passing through a town



Two Tone Electric Auto Horn.

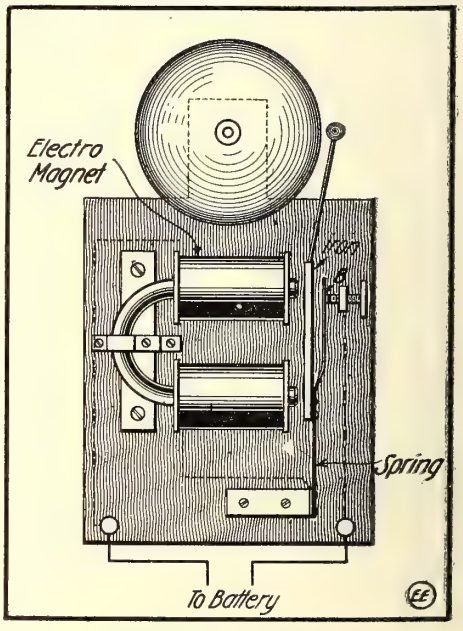
at late hours, as some electric signals are very unpleasant to the near-by inhabitants. A simple way to work the above scheme out is to make a double contact push button, which is very clearly explained in the diagram given herewith.

Two or three feet of No. 22 or 24 soft iron or German silver insulated wire will be about right for the average electric signal, such as is used on automobiles and motor boats. A very convenient place for the resistance can be made by cutting a groove in the base of the push button, as shown in Fig. 2. By pressing the button slightly the signal will sound about half tone; press the button a little harder and the signal will sound at full tone. Contributed by H. CORCELL STUART.

THIRD PRIZE $1.00.

A HOME-MADE ELECTRIC BELL.

To make a cheap yet satisfactory electric bell cut out a small board, six inches square with a one-inch square projection at one end, as illustrated. To this board screw a block of wood, 3x½x½ inches, and fasten an electromagnet to the latter, as shown. In the center at the bottom of the board attach another block, 1x½x½ inch, and to this screw a piece of clock or brass spring with a soft hammer affixed, which should be long enough to extend past the two ends of the electromagnet. On the inside of this spring rivet a small brass strip and then solder a piece of silver on it. Then bend the brass strip, as depicted in sketch. A small thumbscrew should now be attached in such



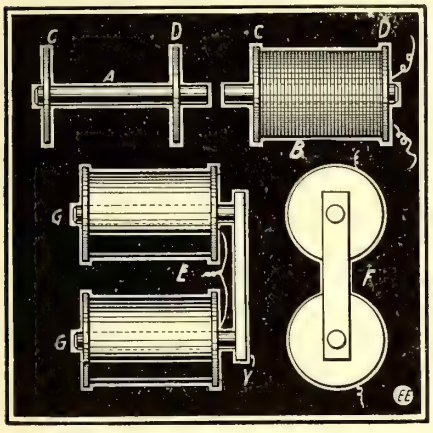
Home-Made Electric Bell.

a manner that the silver point of same touches the silver on the strip. An old bicycle or alarm bell gong is fastened by a screw to the projection at the top of the board, and the wiring arranged as per outline herewith given. We now have a complete and useful little electric bell that will be found very serviceable. If desired, two binding posts may be fastened to the end of the base. Contributed by WILLIAM WINTERS.

HINTS ON ELECTRO-MAGNETS.

The principle of most electric instruments, as well as machinery, is based upon the electro-magnet, for the construction of which the following directions will be found very serviceable.

First, remember that the nearer to the iron core the coils are wound, the stronger the magnet. Secondly, a magnet does not increase in strength materially after the wire is wound on deeper than the diameter of the core. That is, if a core is ½ inch in diameter it should not be wound to a diameter of over 1½ inches. If a weak current is used, wind with small wire; the less current utilized, the smaller the wire. For telegraph coils and bells use about ½ inch core 2½ inches long, and wind to a diameter of 1 to 1¼ inches with No. 24 or No. 26 copper wire. To make a single magnet, take a large wire nail or soft round iron bar 2½ to 3 inches long. Cut a circle of stiff thin wood or cardboard and, after fastening it on the bar, wind with No. 26 or 28 magnet wire, taking care not to injure the insulation. Apply a coat or two of gum shellac or dip in melted paraffine for a few minutes, and dry. Fig. A shows bobbin of magnet ready to be wound; at Fig. B it is already wound. C and D are the discs of wood or cardboard, and E illustrates a double magnet. A side view of the magnet is shown at F. The iron cores G G may be riveted onto the iron yoke Y or secured by machine screws. The yoke Y should have the same cross-sectional area



Hints on Making Electro-Magnets.

as the cores G, or even a greater area. Tapering the pole faces as shown increases the pull on the armature, as it raises the flux density at this point. Contributed by

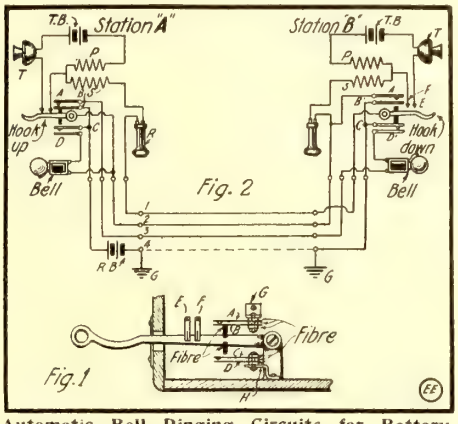
E. THOMPSON.

STUNT FOR BATTERY TELEPHONES.

Herewith is a handy time-saving stunt for those using ordinary battery telephones.

In Fig. 1 E and F are the regular talking contact springs, E going to the transmitter and F to the induction coil, P and S, see Fig. 2. G and H are brass arms, serving as supports for the springs, A, B, C and D. These springs are made of spring brass, and are about 1½ inches long, 3-16 inch wide and quite stiff (about No. 24 gauge). The springs, A and C, have a piece of platinum wire inserted at their ends, which make contact on two pieces of platinum foil on springs, B and D. The springs A, B, C and D are insulated from each other and from their supports by means of fiber washers between them, and the whole clamped together by a screw and nut, as shown. On top and bottom of the hook saw or file out two recesses and fit into them two pieces of fiber ⅜ inch square by ⅛ inch thick. These actuate he springs A, B, C and D. The hook spring, tending to push the hook up, is not shown for the sake of clearness.

Referring to Fig. 2 it will be seen that four wires are required for a full metallic system; but inasmuch as the No. 4 wire is used for ringing only, it may be substituted by the ground as shown, the dotted line in-



Automatic Bell Ringing Circuits for Battery Telephones.

dicating the No. 4 wire if used. By following out the circuits in Fig. 2 it will be evident that raising the receiver from the hook at station A, will ring up station B, which will continue to ring until B answers his telephone or A replaces his receiver on the hook. R B is the common ringing battery for the system. Wires 1 and 2 are used for talking and wires 2, 3 and 4 (or ground) for ringing. There are no push buttons or switches to operate in this improved system, and only three wires are really necessary.

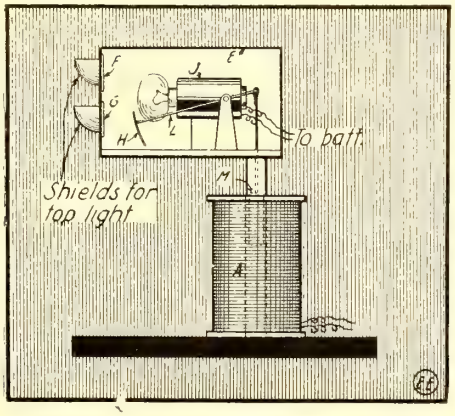
Contributed by

FRANK G. CASEY.

A MINIATURE ELECTRIC RAILWAY SIGNAL.

Those interested in small electric railways in miniature will probably like to construct a double lamp signal, electrically operated by a solenoid magnet, as the sketch here shows. It is very simply made and a single, low voltage battery lamp serves the purpose.

Referring to the sketch, A is a solenoid coil, corresponding to an ordinary bell magnet and inside of this a movable iron core M can slide up or down. This sliding iron plunger M is joined to a pivoted arm L. On the end of this arm is mounted a shutter H. Two small shields with



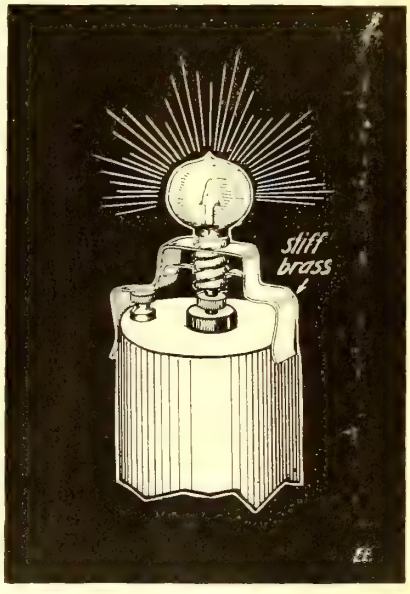
Two-Way Miniature Electric Railway Signal.

white and red glasses F and G are mounted in one end of a light-proof casing E. J is a minature lamp socket holding the small tungsten lamp, as observed. This lamp is supposed to be kept burning, while the miniature railway is in operation and the white and red or green and red signals, as desired, are shown alternately, by suitably arranged automatic or other switch contacts, to open and close the solenoid coil circuit. The solenoid may be wound with about 40 yards of No. 26 magnet wire or with a somewhat larger wire than this. Contributed by

I. WITT.

A HANDY BATTERY LAMP MOUNT.

The following is the description of a handy and simple mount for lamps. Procure a sheet of springy brass and cut a strip about 5 inches long and 1 inch wide, but leave a hole in the center large enough to admit a miniature lamp adapter. This is to be placed in the hole and supported by two pieces of brass, bent and soldered, as clearly shown in the sketch. The brass (large) strip, of course, must also be bent exactly as shown in sketch. Then, lastly, screw a lamp into the adapter and the device is ready. Snap it on to a dry cell and it is ready for use, as shown. The battery cannot be short circuited, as the brass strip is in connection with the zinc when attached and the carbon of the battery individually in connection, with the base of the lamp just protruding a little so that carbon, screw and base of lamp touch. If the light is not wanted the lamp may be



Simple Lamp Adapter for Dry Cells.

slightly turned to the right, thus opening the circuit. If battery is run down the outfit can be quickly clasped to another in three seconds.

Contributed by

HENRY BOWEN.

QUICKLY MADE CONDENSERS.

When in need of a small condenser for receiving, one can be easily made as follows:

Procure a small memorandum or notebook (such as those given away to advertise medicine, etc.) and some tin-foil. Cut the tin-foil sheets a trifle smaller than the leaves of the book and insert a sheet of foil between each leaf until the desired number of sheets are obtained to give the proper capacity, allowing the ends to protrude alternately on each side for connections.

Should a permanent condenser be required, the book containing the foil may be soaked in hot paraffine wax and pressed with weights; then mount it in a case. But for temporary use a weight placed on the book is sufficient. Contributed by

FRANK HAVERLAN, JR.

"AND THE WORM CAN'T ESCAPE!"

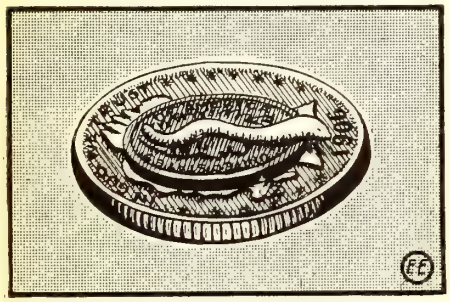
A rather peculiar experiment may be performed with the following articles, to wit: One worm (ordinary garden variety), one copper coin and one silver coin. The copper coin is placed on top of the silver coin, and it should be about 3/16 inch at least smaller all around than the silver piece. If now the worm is placed on top of the copper coin, it will be found that it cannot get off same, as every time he gets his damp body in contact with the two different coins it sets up an electro-motive force through the circuit so provided, which gives Mr. Worm, of course, an appreciable shock; so much so, in fact, that he prefers to stay on the top coin.

Contributed by G. HUGO.

[*What happens to such an experiment as this, in case the worm is kept on the top coin long enough to become thoroughly dry, the author of the experiment does not state.—Ed.*]

It will probably make the worm turn!

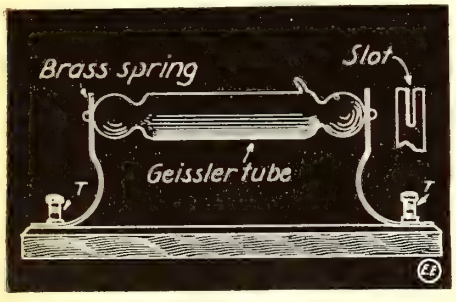
G. H.



The Worm Can't Get off the Coins.

A GEISSLER TUBE STAND.

Many experimenters have no doubt often wanted to know a simple way in which to mount Geissler tubes. Here is a way to mount it. Obtain a piece of wood, marble or glass. Take the brass parts from an old flashlight battery and bend them as seen in the sketch. Cut or file slots in both springs and the tube can then be snapped into place. The secondary spark coil leads



Geissler Tube Stand.

connect to the two binding posts, TT.

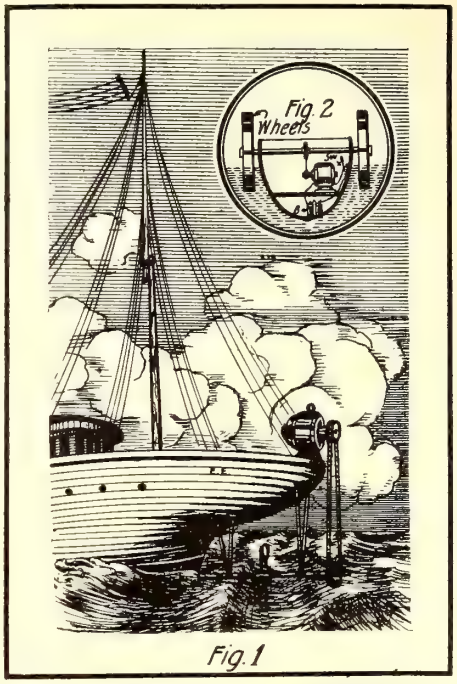
Contributed by LLOYD STRATTON.

ORGANIZE WIRELESS SOCIETY AT ATLANTA, GA.

A wireless society has been organized at Atlanta, Ga., to advance the interests of wireless amateurs and is known as the Atlanta Radio Club. Communications from amateurs within 100 miles from Atlanta are solicited by the club.

Amateur operators, or those wishing to become such, are requested to interchange ideas with the members of this society. All correspondence should be addressed to M. A. Herzog, secretary, 16 Faith street. Atlanta, Ga.

A MOTOR ATTACHMENT FOR BOATS.



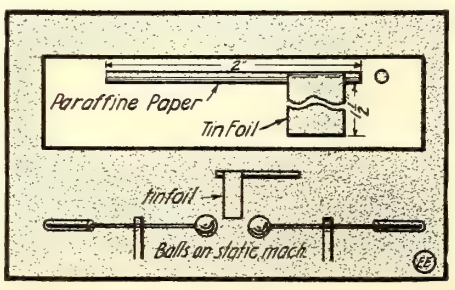
Attaching Small Battery Motors to Model Boats.

Toy boats, such as miniature yachts, sailboats, etc., can be electrically propelled by means of a motor acting as the chief propelling agent. Sketch at Fig. 1 shows how motor is fastened on the end of boat, and by means of its shaft and belting is propelling the vessel by turning the shaft of the propeller, fastened and supported by two wire supporters "A." For battery power a 3-volt Radio Nitrogen Battery is the choice, instead of loading the vessel with less powerful one delivering only 1½ volts or so. Two of these powerful cells will operate the motor at a terrific speed and will rapidly propel the vessel it is attached to. Paddle wheels can also be used. Two should properly be employed, and the diagram at Fig. 2 shows the arrangement for this method, if preferred. The cells of battery can be placed in the lower part of the vessel and can be controlled by a switch conveniently located. Contributed by

WM. WARNECKE, JR.

A STATIC EXPERIMENT.

Here is an experiment for static machines. Take a piece of paraffine paper about 2 inches long and roll it. On this paste a piece of tinfoil and let it hang down about 1½ inches from the paper. Now place the paper in left hand and hold over the balls on the machine. Start the static



Static Machine Experiment.

machine and then let go and watch the tinfoil fly back and forth very rapidly.

Contributed by A. J. BOLDIZAR.

HOW TO FROST GLASS.

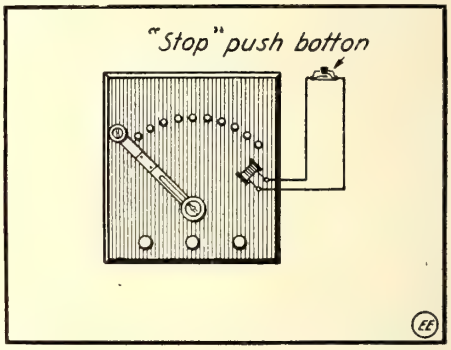
By proper chemical treatment glass electric bulbs will have the same appearance and do the same work as glass subjected to grinding.

In 2 ounces of ether dissolve 90 grains of gum sardarac and 20 grains of gum mastic. One ounce of fresh benzole is added later. The solution should be poured quickly and evenly over the surface to be frosted. Contributed by

W. WESTON.

QUICK STOP FOR ELECTRIC MOTORS.

One of the simplest ways in which to stop an electric motor employing the usual no-voltage release type starting box, is to connect a push button across the electro-magnet on the face of the box. When this push button is depressed it short-circuits the magnet coil and the arm of the starting box is quickly released, cutting off the power to the motor.

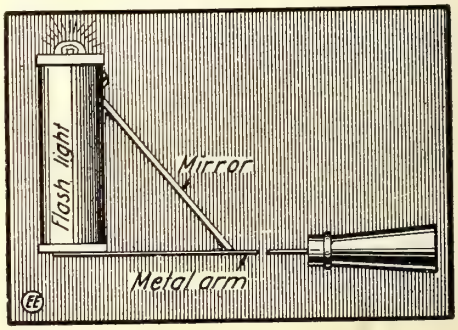


Quick-Stop Motor Control by Push Button.

This principle is used to a great extent in the various styles of push button type electro-magnetic controllers on the market.

A "WALLOSCOPE" FOR ELECTRICIANS.

The drawing herewith shows what I have termned a "Walloscope;" it will be found of great help to electrical contractors, wiremen, machinists, or in fact anyone



Wall Inspecting Lamp for Electricians and Others.

who in the course of his work finds it necessary to employ a special instrument to look into places which cannot be seen otherwise. The following device will be found very handy in such a case:

It consists of a regular small size pocket flashlight fastened on the end of a handle, which also carries a mirror, in which to view corners with, etc. Contributed by

CARL S. DRESS.

AMATEUR WIRELESS STATION NEARLY READY.

The boys of Mt. Sterling, Ill., have their wireless station about ready and expect to be able to receive messages in a few days. When this is in running order, the weather reports sent out by the Government from the Illiopolis wireless station will be picked up by them.

WRINKLES — RECIPES — FORMULAS

Edited by S. GERNSBACK

Under this heading we will publish every month useful information in Mechanics, Electricity and Chemistry. We shall be pleased, of course, to have our readers send us any recipes, formulas, wrinkles, new ideas, etc., useful to the experimenter, which will be duly paid for, upon publication, if acceptable.

EXPERIMENTERS APHORISMS.

In the following, we wish to give to the Experimenter some hints as to the use of the different ingredients and how to work them:

(1) Always bear in mind that exact working of a formula requires ACCURACY, CLEANLINESS, PATIENCE, and SKILL.

(2) Know what you are about, before you start to experiment.

(3) "THE HISTORY OF FAILURES IS THE HISTORY OF SUCCESS" goes an old adage, and it applies well to the experimenter.

(4) Many times impure, wrong or deteriorated raw materials, spell FAILURE instead of SUCCESS.

(5) A great many of the chemicals and ingredients required, cannot be obtained from drug stores; buy them at a reputable supply house.

(6) BEFORE CONDEMNING A FORMULA, be sure the fault does not lie with the manner of handling it, or the purity of the ingredients.

(7) Be sure to mix the materials comprising a certain formula in the proper sequence.

(8) When starting to prepare a mixture, especially one containing liquids, ask yourself: "IS THE SPECIFIC GRAVITY CORRECT, AS INDICATED BY A HYDROMETER? IS THE TEMPERATURE RIGHT? IS THE QUANTITY OR WEIGHT RIGHT?

(9) Acids and water, when mixed, should be manipulated in the proper manner, i. e., THE ACID SHOULD BE POURED INTO THE WATER, and not vice versa, as the solution is liable to be forcibly ejected from the containing vessel and into the mixer's face.

(10) For any kind of SYSTEMATIC WORK, a floating THERMOMETER and HYDROMETER, as well as measuring glasses and scales, should always be provided, as GUESSWORK is EXPENSIVE, and SOMETIMES FATAL.

(11) Put labels on ALL bottles, boxes and packages with FULL INSCRIPTION as to their contents, it will avoid troubles and mistakes.

(12) Remember that a beginner cannot expect to make articles AT FIRST, which will compare with regular manufactured products.

FORMULA 13.
Welding.

Welding Composition.—Dissolve in water 30 parts of *Borax,* 4 parts of *Sal Ammoniac,* 4 parts of *Cyanide of Potash.* Evaporate the water at a low temperature.

Welding Flux.—Pulverize the following ingredients: 2 oz. of *Copperas,* 1 oz. of *Saltpeter,* 6 oz. of *Salt,* 1 oz. of *Oxide of Manganese,* 1 oz. of *Cyanide of Potash.* Mix together with 3 lbs. of good *Welding Sand.*

Welding Powders.—Calcine and pulverize together 50 parts of *Iron Filings,* 5 parts of *Sal Ammoniac,* 3 parts of *Borax,* 2½ parts of *Copaiba Balsam.*

To Weld Cast Iron.—Take of good, clear *White Sand,* 3 parts; *Refined Solton,* 1 part; *Fosterine,* 1 part; *Rock Salt,* 1 part; mix all together. Take the two pieces of cast iron, heat them in a moderate charcoal fire, occasionally taking them out while heating and dipping them into the composition until they are of a proper heat to weld, then at once lay them on the anvil and gently hammer them together.

To Weld Cast Iron.—The best way of welding cast iron is to take it at a very intense heat, closely approaching the melting point. In this state it will be found sufficiently malleable to stand welding by the hammer.

Composition Used to Weld Cast Steel.—10 parts *Borax,* 1 part *Sal Ammoniac.* Grind or pound them thoroughly together, then fuse them in a metal pot over a clear fire, taking care to continue the heat until all spume has disappeared from the surface. When the liquid appears clear the composition is ready to be poured out to cool and concrete; afterward being ground to a fine powder, it is ready for use. To use this composition the steel to be welded is raised to a heat which may be expressed as "bright yellow." It is then dipped among the welding powder and again placed in the fire until it attains the same degree of heat as before. It is then ready to be placed under the hammer.

Composition for Welding Cast Steel.—Pulverize borax, any quantity, and slightly color it with dragon's blood. Heat the steel red hot, shake the borax over it; place it again in the fire till the borax smokes on the steel, which will be much below the ordinary welding heat, and then hammer it.

German Welding Powder.—4 parts *Iron Turnings,* 3 parts *Borax,* 2 parts *Borate of Iron,* 1 part *Water.*

Welding a Small Piece of Iron Upon a Large One, with Only a Light Heat.—It is often desirable to weld a small bit of iron upon a large bar, when the large piece must be heated equally hot as the small one. To save this take *Borax,* 1 lb., *Red Oxide of Iron,* 1 to 2 oz. Melt them together in a crucible, and when cold pulverize it and keep the powder dry for use. When you want to perform the operation, just bring the large piece to a white heat, having a good welding heat upon the small slip; take the large one from the fire and sprinkle some of the powder upon the place, and bring the other upon it, applying the hammer smartly, and the weld will be as good as could be made with the greater heat without the powder.

Belgian Welding Powder.—1,000 parts *Iron Filings,* 500 parts *Borax,* 50 parts *Balsam of Copaiba or other resinous oil,* 75 parts *Sal Ammoniac.* Mix all well together, heat and pulverize completely. The surfaces to be welded are powdered with the composition and then brought to a cherry-red heat, at which the powder melts, when the portions to be united are taken from the fire and joined. If the pieces to be welded are too large to be both introduced into the forge, one can be first heated with the welding powder to a cherry-red heat and the other afterward to a white heat, after which the welding may be effected.

S. G.

FORMULAE FOR INVISIBLE INKS AND SILVER PLATING.

No. 1.—20 parts water, 1 part sulphuric acid. Add the acid to the water and not the water to the acid. Unless care is taken that this is done, the heat developed by the dissociation of the acid may break the vessel. Use with a clean steel pen, and when writing is dried it will become invisible, unless the pen has scratched the surface. To read, hold the paper for a moment near a red-hot stove or before a gas flame.

No. 2.—1 oz. citrate of potash, 5 oz. water. Make a complete solution and use same as No. 1.

Sympathetic Ink.

Dissolve chloride or nitrate of cobalt in water. When warmed slightly before a fire the writing will show; on exposure to moist air it will disappear.

Silver-plating Fluid.

One oz. silver nitrate, 12 oz. rain water. Dissolve and add 2 oz. of potassium cyanide. (The latter should be carefully handled, as it is poisonous.) Clean the article thoroughly and apply the fluid by rubbing. The fluid may be used on detector parts, but as the deposited film of silver is not very substantial it would not do for articles which are to be continually carried in the pocket, etc. Contributed by

A. D. R. FRASER.

Why not subscribe to-day? Don't miss the many good articles in store for you.

REGARDING WOOD STAINS, ACIDS AND INVISIBLE INKS.

I wish to call your attention to the invisible ink recipes on page 100 of the July, 1915, issue by Mr. K. K. Knaell, particularly to No. 3. I have used with very good success a formula composed of 50 grains of chloride of cobalt, 1 ounce of water and 10 minims of glycerine; the latter being added to give body to the writing fluid. I think if the formulas mentioned by Mr. Knaell had this addition the writing quality would be increased.

The Proper Use of Sulphuric Acid.

This article is written for the benefit of amateur electrical and wireless experimenters as well as those interested in chemistry, not familiar with the dangers which may arise if sulphuric acid is not properly used.

Sulphuric acid is chiefly used in electrical experiments in the construction of electrical batteries. It is commonly and commercially known as "sulphuric acid," but there are other names under which it is termed and sold, i. e., "hydrogen sulphate," "hydric sulphate," "oil of vitriol," etc.

It is a thick, heavy, oily, sour and corrosive liquid, and in its pure state is without odor or color. It boils at 338 degrees and freezes at about zero.

The fact has been repeatedly illustrated in experiments already performed that sulphuric acid has a very strong tendency to absorb water and form compounds with it, thereby causing great heat to be formed in this action, and attention is called to the necessity for caution in mixing the liquid.

ALWAYS POUR sulphuric acid IN SMALL QUANTITIES INTO the water while stirring the same VIGOROUSLY. It is also well to work with such chemicals as sulphuric acid, nitric acid, hydrochloric acid, etc., where a draught of air can be created to prevent the poisonous fumes from being inhaled into the lungs.

Wood Stains.

To stain ebony, mix: Solution A—Water, 10 ounces; sulphuric acid, 1 ounce. Brush on and allow to sink into the wood to be stained, and then hold close to a fire for a few minutes, in which time a rich black is produced.

Solution B—Strong solution of aniline in alcohol or French polish.

To Stain Walnut.—Potassium permanganate, 60 grains; water, 10 ounces. Used weaker it imitates oak.

To Stain Green.—Solution A—Verdigris 4 ounces; vinegar, 40 ounces. Solution B—Indigo, 1 drachm; vinegar, 20 ounces. Boil each for 10 minutes. Mix according to tint. Average proportion: (A) 6 ounces: (B) 1 ounce. Contributed by

A. WILSDON.

WIRELESS PLANT BASIS OF SUIT.

Vice-Chancellor Stevens, in an opinion filed in the Trenton, N. J., Court of Chancery Aug. 2 last, denied the application of a German corporation for the postponement of the hearing and determining of a suit brought in the Court of Chancery of New Jersey by a French corporation to compel the German concern to carry out an alleged contract to dispose of its wireless telegraph station at Tuckerton, N. J., to the French corporation.

The Germany company in its answer to the suit denied knowledge of the contract and asked that a hearing and determining of the case be deferred until after the close of the present war.

The name of the German company is the Hoch Frequenz-Maschinen Aktien-Gesellschaft für Drahtlose Telegraphie of Berlin. The French corporation is the Compagnie Universelle de Télégraphie et de Téléphon sans fil, with offices in Paris.

AMONG THE AMATEURS

AMATEUR RADIO STATION CONTEST.

Monthly Prize, $3.00.

This month's prize winner.

PAUL SHNEY'S AMATEUR STATION.

The following is a description of my radio receiving station:

Receiving—A home-made duplex loading coil with primary slider and secondary switch with seven points, a loose coupler, a variable and fixed condenser. For convenience in quickly changing from long to short wave length, and vice versa, the switch at the left of the loose coupler is used to short circuit either the primary of the loader or the series condenser. A 3-point detector switch is used to connect at will a Radioson detector, a silicon or a galena detector. The operative detector is connected in series with a "junior" fixed condenser. The "junior" condenser is bridged by two 1,000-ohm receivers in



Paul Shney Enjoys to the Full His Excellent Wireless Set.

series, while the ½ M. F. condenser is bridged by two watch case receivers in parallel. Some wires connected to the other leads enable four people to hear at once, and are also used as a buzzer telegraph line for experimental purposes. The switches and rheostat at the bottom of the board are used to control these circuits, as well as the coherer and polarized relay for audible reception of signals.

My aerial is 125 feet long and spaced 2 feet 8 inches apart. Iron pipe spreaders 11 feet long are supported at the upper end to the roof of a three-story hospital. The maximum wave length of primary and secondary are each about 5,000 meters. Weather conditions prevent me from hearing WSL and NAA occasionally.

PAUL F. SHNEY.

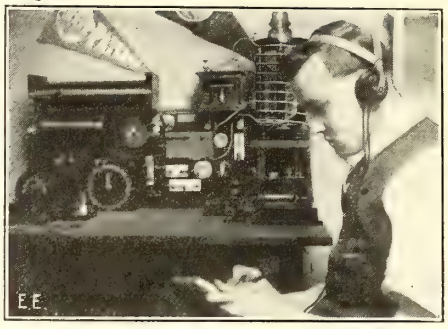
Pittsburgh, Pa.

The United States navy will establish a wireless station on Cape Cod especially equipped to guide vessels along the Atlantic coast in time of fog.

Within a few months wireless messages have been sent from a station in this country to Paris. They are sent direct and not relayed from ships.

A SUCCESSFUL RADIO STATION.

Herewith will be found a photograph of my radio laboratory which I wish to enter in your contest. As you will notice, the set is practically all home-made, but I get excellent results. I am now experimenting with a one-wire antenna 150 feet long and 65 feet high at one end and 80 feet at the other.



Harold Mason at His Radio Set.

For sending I use a 2-inch spark coil, operated on dry cells, helix, adjustable plate condenser, "Electro" vertical gap inclosed in cabinet and key. I have a small medical coil with which I can send short distances. I have also a complete buzzer test in circuit.

For receiving I have one large single slide tuner, one loading coil, receiving transformer, pancake tuner with 25 taps, one "Electro" fixed condenser, one mineral detector for galena, silicon or iron pyrites and one head set of 1,000-ohm receivers.

I hereby wish to state that I agree with other amateurs that galena is the best of all minerals in use.

Paterson, N. J. HAROLD MASON.

HAROLD BENNETT'S WIRELESS PLANT.

I give you herewith photo of my wireless set, which I should like to appear in your magazine. Starting from the left will be observed my receiving set, which consists of one loading coil, variable condenser, fixed condenser, a galena detector, tuning coil and a pair of 2,000-ohm 'phones. In my sending outfit I use a ¼-inch Bulldog spark coil, two glass plate condensers (home-made), one large helix, spark gap, key and double throw switch. The latter articles are all home-made.

My aerial is built on top of a school building and I can receive up to 1,000 miles and send about four. I can hear (I. W.



Harold Bennett's Radio Station.

Co.) Illinois Watch Co. very clearly.

HAROLD BENNETT.

Clarinda, Iowa.

DONALD HOFFMAN'S WIRELESS OUTFIT.

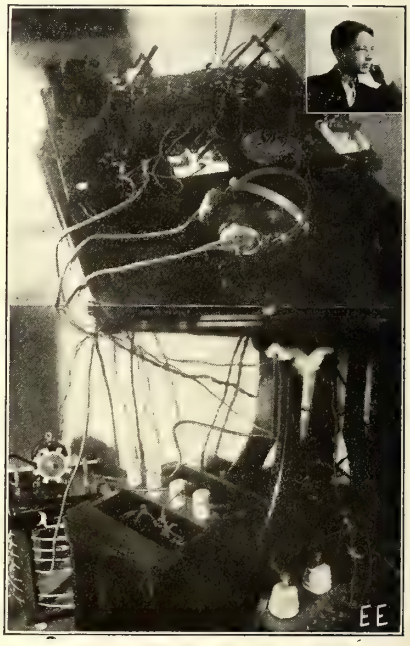
Your last few issues of the *Electrical Experimenter* have made it my favorite electrical magazine. Perhaps its readers will be interested in a brief description of my wireless station.

Sending set: Packard ½ K. W. transformer, home-made glass plate condenser connected series-parallel, rotary spark gap, home-made oscillation transformer, key, switches and rheostat.

Receiving set: Selective coupler, Blitzen loading coil, rotary variable condenser across secondary circuit, Brandes' 2,000-ohm receivers, Crystaloi detector and buzzer test, galena detector and small fixed condenser in shunt with receivers.

I have two aerials of copper-clad wire, both well insulated and provided with proper lightning switches and ground wires. The small aerial is "L" type with four wires, 57 feet long and 30 feet high and is used for sending. The large one is of the "T" type with two wires, 210 feet long; both aerials used for receiving.

I also have wire connection to another



The Efficient Radio Outfit of Donald Hoffman.

boy's house, two blocks away, over which we conduct numerous experiments in wireless, telephony, telegraphy and other forms of communication.

The local amateur and commercial stations all come in fine, as do Arlington, Sayville, Detroit, Cleveland, Canton, Key West and others. Extension receivers and buzzer test control in my bedroom enable me to listen in at any time I care to.

The outfit is mostly all on or under a table, easily accessible, and in as small a space as possible. All wiring and other work of this nature was done by myself, including the electric-light wiring, which was necessary in order to use the transformer outfit. I keep wireless maps, photos and wiring diagrams posted on the wall for instant reference by myself or visitors. I have a Government license and an official call, "8 A.D.U."

DONALD HOFFMAN.

Akron, O.

"THE AMATEUR SCIENTISTS."

A new wireless association known as "The Amateur Scientists" was organized a short time ago and constitutes the following members: J. G. Dashafsky, W. Wernick, O. Dubs, E. Duskis, H. Fienberg, A. Feldman and S. Bosowitz.

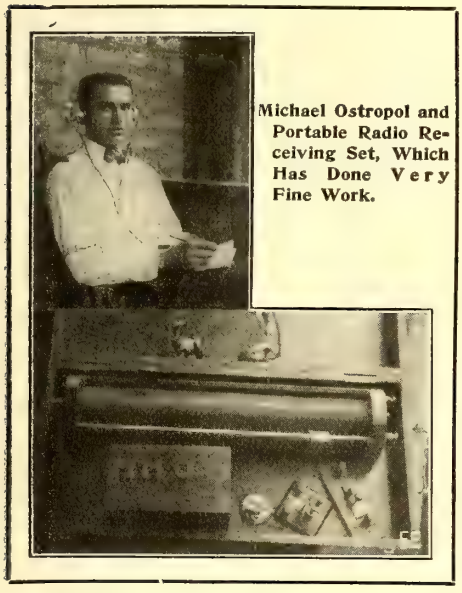
The purport of this society is to make the acquaintance of young scientists and people scientifically inclined. All communications should be addressed to Ephraim Duskis, press agent, 1423 St. Marks Ave., Brooklyn, N. Y.

OSTROPOL'S RADIO STATION.

The accompanying photograph portrays my radio receiving (portable) station, which I constructed myself and from which very successful results are obtained.

This set is composed of a double slide tuner, 20 inches long and 4 inches in diameter, wound with No. 20 enameled copper wire, a variable condenser, two crystal detectors, a test buzzer and two 3,000-ohm head 'phones. This outfit is mounted in a highly polished oak cabinet 22 inches long, 11 inches wide and 6 inches deep, which opens by means of folding doors. Four binding posts, two on each side of cabinet, enable me to operate the set without opening the doors.

I wish to say that I have gained most of my ideas from the *Electrical Experimenter*, of which I am a constant reader.



Michael Ostropol and Portable Radio Receiving Set, Which Has Done Very Fine Work.

MICHAEL OSTROPOL.

Chicago, Ill.

JEANNETTE, PA., BOY WIRELESS OPERATOR ON THE TEXAS.

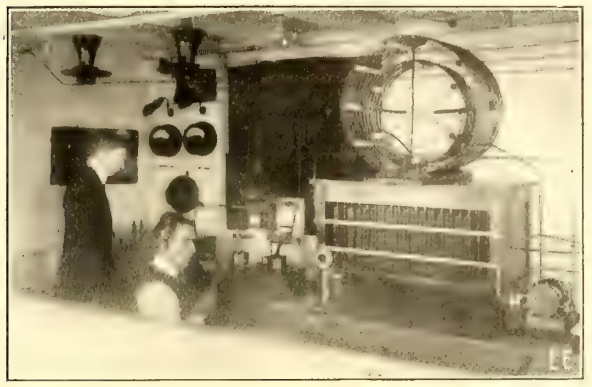
Relatives have received word from Simon J. Murphy, a popular young man of this town, telling of his successful appointment as wireless operator on the United States dreadnaught "Texas," and of the aquatic maneouvers of that huge fighting vessel of Uncle Sam's navy in Gulf waters.

"We are en route South for maneouvers and target practice; thence to Mexico, it is believed. Everything looks very encouraging to me, and my chances to become a 'radio gunner,' as it is termed, are very good," he said.

Young Murphy received the appointment recently and is in full charge of the "wireless room." He is a graduate of the United States navy electrical school.

A SUCCESSFUL WIRELESS TELEPHONE AND TELEGRAPH STATION.

The accompanying photograph shows Earl Hanson and Hadys Hancock operating the private wireless telephone and telegraph station on Venice pier, California.



Wireless Telephone and Telegraph Station of Earl Hanson and Hadys Hancock.

On the table at the left and under the switchboard is shown a mahogany case containing the wireless telephone apparatus. Among the various systems tried the 60-cycle arc gives all around results and holds up under long tests. It may be well to say here that much value has been derived from your articles on wireless telephony appearing in the *Electrical Experimenter*.

Above the switchboard can be seen the large high-tension insulators connecting the aerial lead to the transmitting set. This consists of a 5-kw. closed core transformer, but to conform with the radio law only 1 K.W. is used. A large glass plate condenser and an inductance, together with a high-speed rotary gap, giving a high note, easily read through interference, completes the set. The connections throughout the station are of large brass and copper tubing, giving the minimum high frequency resistance.

In the center of the photo, just below the aerial switch, is depicted the latest type receiving set. The aerial, made of E. I. Co. stranded "Antenium" phosphor-bronze cable and situated on the pier, is 300 feet long and 100 feet high. With the ocean for a ground, surprising receiving distances are accomplished. Nature also helps here, for the Pacific coast is not so heavily charged with the static that is encountered on the Atlantic seaboard.

EARL C. HANSON.

Los Angeles, Cal.

RADIO EQUIPMENT OF HUBERT M'ILVAINE.

Herewith is a photo and description of my wireless station. The sending outfit consists of a 1½-inch spark coil, home-made condenser of photo negatives and tinfoil, helix, spark gap, sending key and 6-volt storage battery.



Complete Radio Set of Mr. M'Ilvaine Includes Amplifier.

For receiving I use a pair of 2,000 ohms E. I. Co. 'phones, galena, silicon, perikon and electrolytic detector, small fixed condenser and a two-slide tuner. I ground my set to a well-pump and derive very efficient results.

With a two-wire 300-foot aerial I have many times heard N. Z. G. (Colon). I can easily receive Arlington (N. A. A.) N. A. R. and 9ZS at mid-day. I find the E. I. Co. galena the most sensitive detector I have ever tried when connected up in the proper way. My wireless outfit is situated on a table in a room, but is portable and was out of doors, as the photo shows.

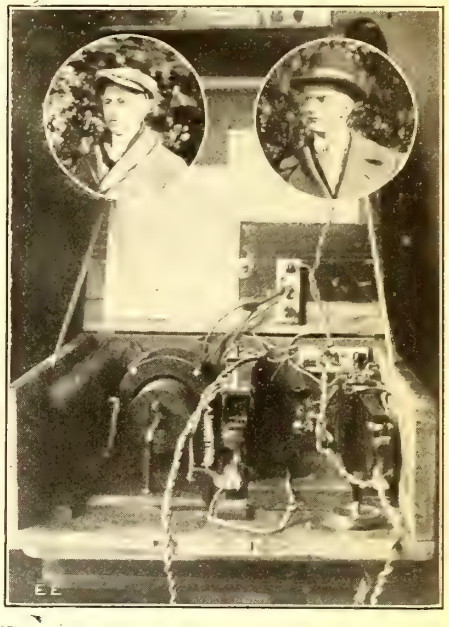
HUBERT M'ILVAINE.

Milroy, Ind.

C. D. PAPPAS AND C. H. RICH'S WIRELESS OUTFIT.

Herewith submitted are three photographs; one of our wireless set and the other of myself and Clinton H. Rich, which I wish to enter in your radio station contest.

Our receiving set consists of a loose coupler, three home-made plate condensers, one large galena detector, one ten-cent galena detector, two 1,000-ohm receivers, one fixed condenser, three home-made loading coils, etc. Our receiving range is 1,200 to 1,500 miles with an aerial 40 feet high and 60 feet long. It consists of four wires; the spreaders being 8 feet long. We can tune up to 2,000 meters.



Messrs. Pappas (left) and Rich, and Their Portable Wireless Set.

CHRISTOS D. PAPPAS.
CLINTON H. RICH.

Haverhill, Mass.

RADIO CLUBS ATTENTION!

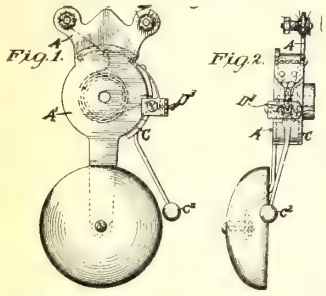
We are always pleased to hear from young Edisons and Radio Clubs. Send a write-up of your Club with photos of members and apparatus to-day to: Editor "Amateur Gossip" Section, The Electrical Experimenter, 233 Fulton St., New York City.

LATEST PATENTS

Electric Alarm Bell.

(No. 1,141,187; issued to Gustav A. Huber.)

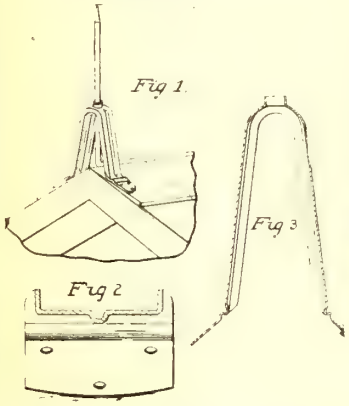
Differing from the usual forms of electric alarm bell construction, this



patentee arranges his bell very simply with a single magnet coil and the iron cheeks A and A^1 of the magnet bobbin attract the vibrating iron armature C, carrying the gong striker C^2. The usual vibrator contact screw D^3 is placed outside of the bell, but the general design is indeed rugged and simplified.

Lightning Rod Points.

(No. 1,140,582; issued to Thomas W. Dodd.)

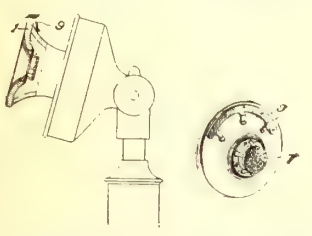


Simplified design for lightning rod points and particularly in rigid bracket supports for same, such as used on pitch-roofed houses. The device is seen in the illustration and the bracket is made from a specially grooved stamping to give maximum strength.

Sanitary Shield for Telephones.

(No. 1,142,600; issued to Russell H. Maxwell.)

A detachable sanitary shield, which may be carried by everyone, is provided for in this patent, and simple means are specified therein



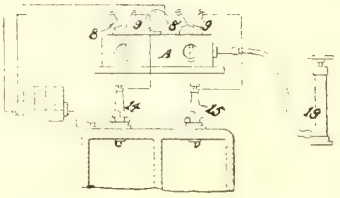
as to methods of quickly attaching and detaching same from telephone transmitters and receivers. Spring clips 9 and 12 enable the user to perform the attachment quickly. The transmitter shield 1 also carries a perforated disc 7, etc.

Auto-Engine Sparking Indicator.

(No. 1,140,816; issued to Claud E. Harlan.)

The inventor of this device intends it for assimilating gasoline engine cylinder conditions in a specially arranged and distinct tank "A." Air pressure, as from a small pump 19, is forced into the chamber "A" and if the spark is all right between the spark plug 8 and 9 terminals under such air compression (which is carried to the same value as that in the engine cylinder), then the ignition system is supposed to be all right. The gauge on top of the chamber measures the air pressure within.

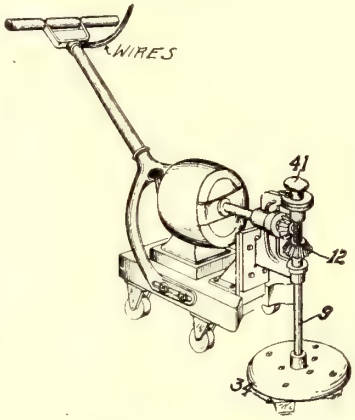
It is difficult to see how this device will show up a short-circuited or befouled spark plug in the cylinder at 14 or 15, particularly as the inventor states specifically that his invention enables engine testers to check up the ignition exactly without removing engine spark plugs 14 or 15.



Electrically-Driven Floor Polisher.

(No. 1,141,287; issued to William B. Thayer.)

A handy form of electric motor-driven floor polisher having several unique adjustable features about it. The polisher 34, having special polishing shoes attached to it, can be raised from the floor and held in that position by a small button 41 and a trip finger on the side of same. The driving pinion 12 is feathered on the vertical shaft 9 of

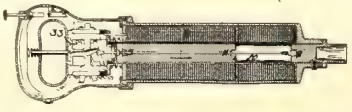


the polisher head to allow of its rising up and down as explained.

Electric Percussion Hammer.

(No. 1,140,447; issued to Achilles de Khotinsky.)

The inventor of this improved electrical percussion hammer for riveting and other work has ingeniously arranged a switching drum 33, controlled by a connecting rod, arranged to be actuated or moved back and forth co-axially by the reciprocating electro-magnetic action of an iron plunger 10. The magnet coils are specially arranged to give the greatest pull on the plunger and also they are made to

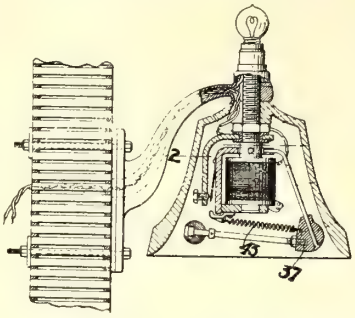


act on the plunger in its return stroke, so that it is magnetically cushioned. A really good invention, it seems.

Electric Signal for Automobiles.

(No. 1,140,492; issued to Harold B. Anderson.)

Electrical signaling device for autos, intended to be attached to the radiator of same. Electric signal

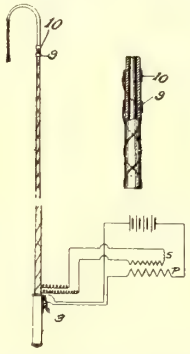


lamp is provided as well as special compact form of electro-magnetically operated bell. A single magnet coil attracts an iron armature 2 and this raises the striking hammer 37 in the bell. A spiral spring 43 helps to return the striking hammer.

Electric Whip.

(No. 1,140,365; issued to Henry C. Dixon.)

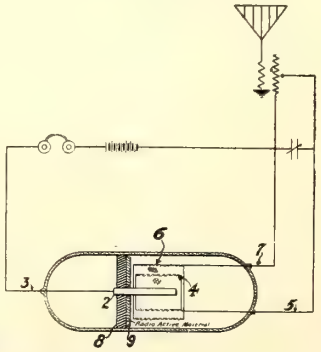
A cleverly arranged whip for



team drivers with two highly insulated electric wires wound spirally along the length of the whip, as shown, and terminating in two metal ferrules "9" and "10." A switch "3" on the handle of the whip controls the primary circuit of a small spark coil. Pressing the button causes a spark to jump from one metallic ferrule in contact with the animal's skin, and so on through the skin to the second metallic ferrule. It is pointed out by the patentee that this arrangement is preferable for team drivers, etc., to that of excessively applying a lash whip which cuts the skin.

Radio Valve Detector.

(No. 1,145,735; issued to Chester Drew Ainsworth.)

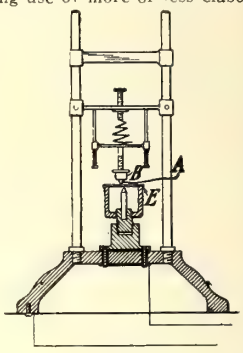


An electronic valve detector for wireless telegraphy, intended to utilize the electron radiations from some radio-active material, such as pitch-blende, etc. As drawing shows, the wireless tuning circuits are hooked up by means of wires, 3, 5, and 7, to three electrodes, 2, 4 and 6. An electron discharge of course is always taking place from the radio-active substances 9, suitably mounted on a disk 8. The incoming etheric waves cause variations in the electronic stream between the electrodes of the valve, similar to the action of the Audion detector. It seems doubtful whether this electron discharge will be strong enough for practical requirements.

New Zinc Compound Radio Detector.

(No. 1,145,658; issued to William E. Ashton and Austen M. Curtis; assignors to J. Odell Fowler.)

An improved wireless detector making use of more or less elaborate

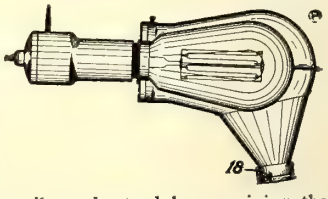


mechanical adjustment frame, as shown, and containing principally as a new feature, a metal cup B, in which is mounted a piece of special zinc compound A, consisting of zinc, oxygen, manganese in the form known as a species of red oxide of zinc. This mineral mass is in contact with a metallic plate or electrode disk E, having half its surface made conductive by facing it with platinum and the other half of it made an insulator by suitable enamel or other means. The detector can thus be cut in or out of circuit by simply turning the disk E.

Electric Egg Tester.

(No. 1,145,466; issued to Frederick W. Dobbel.)

Another form a electric egg tester,

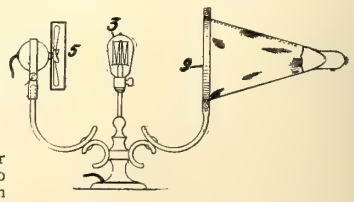


easily understood by examining the drawing. The inventor provides a metallic shell divided hemispherically, so as to be placed over an incandescent lamp by means of a suitable holder, as described. The egg to be inspected, is placed in the opening 18.

Electrical Insect Trap.

(No. 1,144,358; issued to Knut George Gyllstrom.)

As can be seen from the illustration, an electric lamp 3, suitably mounted, serves to attract the insects and they are then blown into a net or catch bag 9, by a strong draught of air propagated by the



electric fan 5. The efficacy of this device is self-evident and several other interesting features are covered in this clever patent.

(Copies of any patent above mentioned supplied at 10 cents each.)

Phoney Patents

Under this heading we will publish hereafter electrical or mechanical ideas which our clever inventors, for reasons best known to themselves, have as yet not patented. We furthermore announce the grand opening of the

PHONEY PATENT OFFIZZ

For the relief of all suffering daffy inventors in this country as well as the entire universe.

We will revolutionize the Patent business immmediately and OFFER YOU THREE DOLLARS ($3.00) FOR THE BEST PATENT. If you take your Phoney Patent to Washington, they charge you $20.00 for the initial fee and then you haven't a smell of the Patent yet. After they have allowed the Patent, you must pay another $20.00 as a final fee. That's $40.00 ! ! WE PAY YOU $3.00 and grant you a Phoney Patent in the bargain, so you save $43.00 ! ! When sending in your Phoney Patent application, be sure that it is as daffy as a lovesick bat. The daffier, the better. Simple sketches and a short description will help our staff of examiners to issue a Phoney Patent on your invention in a jiffy.

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PHONEY PATENT AFFIRMED, ALOYSIUS DODGASTIT

No. 71177.95 **ROCKAWAY MOTOR** **Patent Applied for 61½ B.C.**

Specifications of Phoney Patent
Hot Application Applied For

To those and whosoever cares:

I, Aloysius Dodgastit, of the City of Hades, in State of Exhaustion, have invented an apparatus to absorb, store, use and control in both its primary and its secondary form, electricity, the energy at present wasted by rocking women.

A woman will, by providing suitable means to a rocker, compress 500 cubic feet of air per hour and by actual experiment I have discovered that five times that amount of energy can be obtained from one unit by tying your mother-in-law in a chair and then kissing your neighbor's wife in front of her. (Not the neighbor's front, of course).

My invention consists first of a bellows placed under the rockers of the rocking chairs in the parlor (1). These chairs are connected by means of a flexible, reinforced tissue paper hose to the outlets fastened to the wall (2). Tissue paper is used to prevent the scratching and marring of the furniture. Flexible metal hose, covered with satin, can also be used if desired.

These pipes lead to a large double riveted and welded tank (3) from which the air passes through pipe (4) and valve (5) to a double acting opposed compressed air engine (6). A dynamo (7) is belted to the engine and the energy generated by the dynamo is controlled by switchboard (8) and conducted to storage cells (9). The surplus power of the batteries is used to light up the house, run ice cream freezers, vacuum cleaners, etc. On the switchboard is mounted a solenoid (10) which has its sliding core connected by means of a rope (11) to the valve (5). The action of this is as follows:

If no current is generated by the dynamo, the weight (12) will open the valve, allowing air to flow into the engine, this starts up the dynamo, which gradually shuts off the air, thereby acting as a governor, viz., if the engine runs too fast, the core in the solenoid will be attracted, the valve slightly closed and the engine will drop to its proper speed.

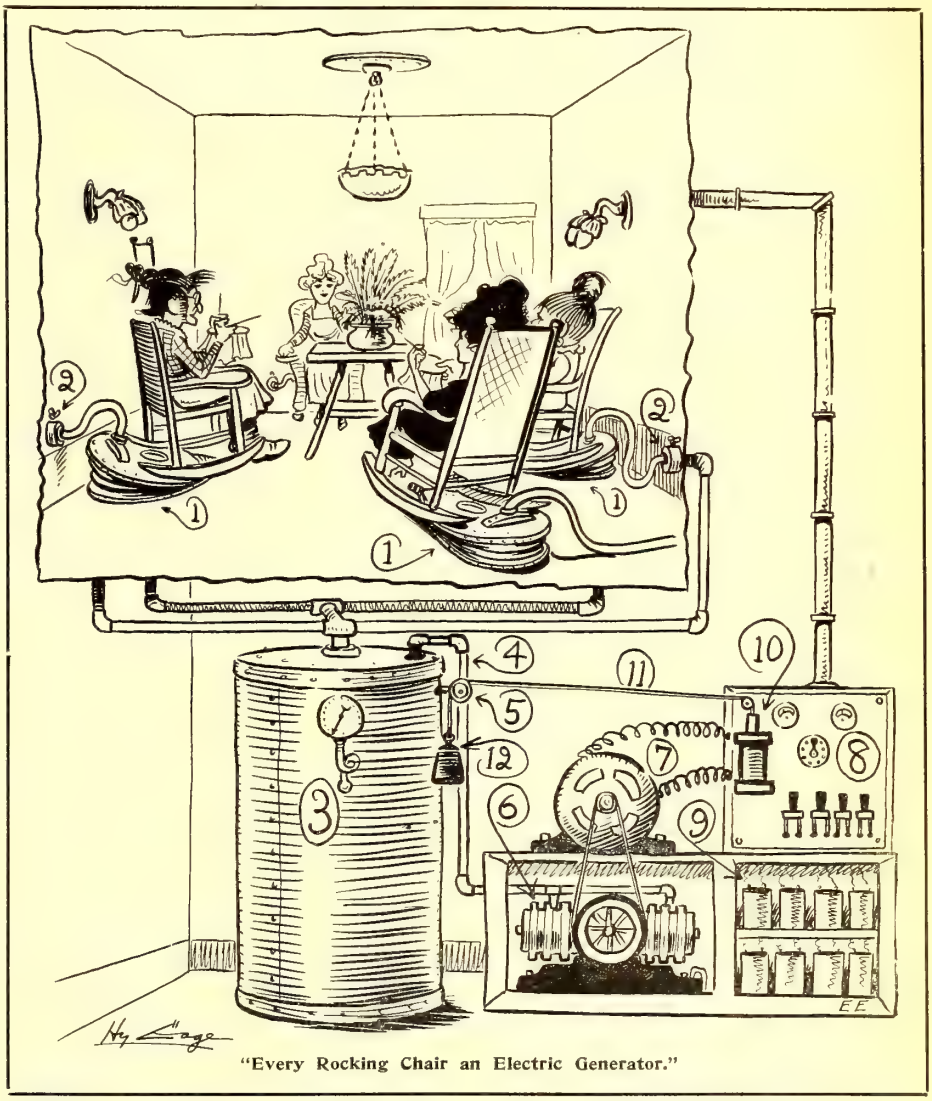
This makes the system automatic and all that is necessary to keep the batteries fully charged is to invite the sewing circle to your home one evening each week and let them rock.

I am patenting this to protect others from making money from the idea, so readers with this patent may go ahead and install one in your own home.

In testimony whereof I have hereunto, for now and for all times, from the beginning of the world till this evening at 9¾ P. M., placed my seal this 20th day of today Anno Domino (sugar) 1991.

ALOYSIUS DODGASTIT,
By his Attorney:
THOMAS W. BENSON,
Philadelphia, Pa.

Witnesses:
O. Pfooee,
G. Wotaboub,
O. Myeye.



"Every Rocking Chair an Electric Generator."

"SOME" SOUNDER.

I wanted to learn telegraphy but had no apparatus; so I invented one.

Here is the description: Take two dessert spoons as per sketch; that's all. Operate as shown. Just try it. It sounds like a real $10 sounder and the speed which you can attain is marvelous. It's all wrong, Baron Münchhausen: it's all wrong!!

Contributed by MULB EGROEG.

[Not having spoons around the office we could not try Mr. "Mulb's" scheme. If



he will send us some of his spoons (solid silver, please), we will try our hand at it. —Editor.]

JAPAN-HONOLULU RADIO.

Wireless communication was successfully inaugurated recently between the new station at Funabashi, near Yokohama, and the Hawaiian Islands. The distance between Funa[illegible] new wireless statio[illegible] Honolulu is

QUESTION BOX

This department is for the sole benefit of the electrical experimenter. Questions will be answered here for the benefit of all, but only matter of sufficient interest will be published. Rules under which questions will be answered:

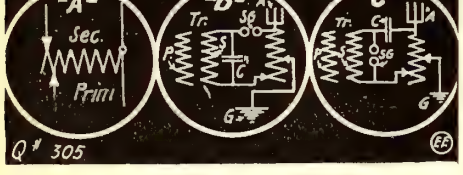
1. Only three questions can be submitted to be answered.
2. Only one side of sheet to be written on; matter must be typewritten or else written in ink, no penciled matter considered.
3. Sketches, diagrams, etc., must be on separate sheets. Questions addressed to this department cannot be answered by mail.

SOME INTERESTING RADIO QUESTIONS.

(305.) R. N. Turner, Fort Smith, Ark., sends us some uncommon questions below which the editor of this column thinks will be sufficiently interesting to warrant their publication, although usually three questions are the limit. We answer herewith some of your queries:

A. 1. A two-slide tuning coil is superior to a single slide tuning coil in wireless receiving circuits, due to the fact that the coil used in this way operates as an autotransformer, or, in other words, this single coil must do the work of a regular transformer, having two coils; the single winding acting both as primary and secondary. Hence it is evident that if the primary and secondary are to be adjustable independently, as they should be, of course, that it is impossible with a single slide coil to obtain independent adjustment of secondary and primary, but that both secondary and primary circuits, so to speak, must be adjusted in one operation with a single slide. Of course, this gives a very narrow latitude to the adjustment possible. With two slides it is evident that a regular loose coupler action can be approximately duplicated, as the diagram "A" shows.

A. 2. It is an indisputable fact, speaking generally, that a tuning coil or autotransformer is the most efficient type of transformer possible to build. This covers such



Diagrams for Query No. 305.

points as strength of signals received, etc. However, in radio receiving circuits there is often so much static and interference to be eliminated that it has been found that, all things considered, a loose coupled transformer with a distinct primary and secondary winding gives the best all-around results, as the selectivity and tuning effectiveness of such an arrangement is of far greater latitude than that possible with a single coil, the sections of which are all metallically interconnected or in one common circuit.

A. 3. Regarding aerials it seems to be a standard practise, both for commercial and experimental purposes to-day, to make use of a plain straightaway type of antenna. This calls for cross-connected strands at the free end of the aerial flat top and at the lead end of flat top. A lead wire is brought down from each strand and joined to a single, heavy, stranded cable preferably.

A. 4. With regard to the connection of the telephone receivers across the detector or across the fixed "blocking" condenser in the radio receiving hook-up you show this is a matter of minor importance, it seems, from our experience and that of others. Both [illegible] are used practically ind[illegible] for a mathematica[illegible] this matter we refer you to an excellent article which appeared in the February, 1915, issue of this journal, copy of which you can procure from the publishers at the regular price.

A. 5. With reference to connecting the condenser in a wireless transmitting set either across the secondary of a high voltage transformer or in series with the closed oscillatory circuit, as diagrams "B" and "C" show, this seems to make very little difference in most cases and both methods have been used indiscriminately on commercial wireless installations for many years on board ship, etc., by several of the foremost commercial radio companies to our correct knowledge.

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The owners of these things wish to ***"swap"*** them for **something else, something which you may have.**

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A. 6. Relative to the increase in strength of received signals caused by a person touching some metallic part of the aerial or by duplicating this condition by means of connecting a large coil of wire of one lead to the aerial we think that this undoubtedly is due to the increased capacity effect created; and, of course, the greater the capacity of an aerial in micro-farads, the greater its wireless activity.

A. 7. Concerning the long 740-foot aerial composed of one conductor acting better than a multiple wire, four conductor, 185-foot aerial for the wireless receiving of long wave lengths, etc., this is due fundamentally to the fact, as proven in a number of cases on record, that a small aerial when "boosted" by loading coils or condensers, etc., will not act to the utmost efficiency in receiving long wave lengths, which have a value greater than about three or four times the natural period of the antenna in question. Hence you will see that a 740-foot aerial wire will, on this hypothesis, receive 2,500-meter wave length much more efficiently in every way than would be possible with a smaller aerial of the multiple wire type.

This principle has been rigidly followed in all of the latest radio engineering developments, including the design of the large Marconi transatlantic station located at New Brunswick, N. J. These stations use tremendous wave lengths of from 12,000 to 15,000 meters value and the aerials conjointly are also very long, being in the neighborhood of one mile in length, following the principle above mentioned.

A. 8. Regarding the mineral "Cerusite" as near as we know this is similar to crystallized galena, or at least samples which we have tested appear to be nothing else. We have found regular cubic formation galena, as commonly used, to be superior to this so-called "Cerusite." Crystal detectors have been used in receiving transatlantic messages commercially, but nowadays some form of vacuum tube amplifier is most generally made use of.

RADIO QUERIES.

(306.) Harold C. Sever, Pleasant Plains, Ill., asks several wireless questions.

A. 1. The aerial arrangement you show should prove satisfactory indeed for wireless receiving, etc. The metal gutters should not have any appreciable effect on your aerial. By "dead ends" on loose couplers is meant the idle turns of the coils not in use when a certain signal is being received. They, of course, produce a large distributed capacity detrimental to the best operation of the set.

You should try some new peroxide of lead in your detector of that type, as these tablets vary a great deal in their sensitivity.

You are correct in assuming that a carrying capacity of 2,000 amperes per square inch of cross-sectional area for copper is common.

The wave length value of the helix turns in use in the wireless transmitting circuit must be added to the aerial wave length proper.

WAVEMETER CALIBRATION.

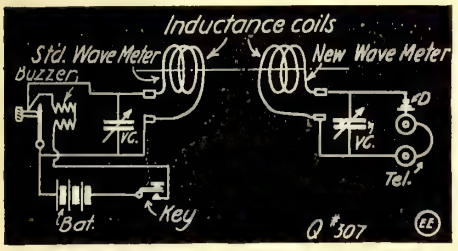
(307.) Warren S. Terriberry, New Bedford, Mass., wants to know how to calibrate a new wave meter from a standardized or master instrument of that type.

A. 1. In calibrating one wave meter by means of another wave meter, which is already calibrated, the general method is to make use of an exciting buzzer, shunted across the oscillatory circuit of the standardized wave meter, as the diagram herewith shows.

The wave meter to be calibrated is then placed sufficiently close to the inductance coil of the buzzer excited standard wave meter and several settings or readings of the condensers are noted and a curve can then be plotted through them in the usual way. For instance, the standard wave meter is set at 10 degrees along the scale of same, and if this corresponds to, say,

200 meters wave length then when the loudest signals are heard in the telephones connected to the second wave meter under calibration (which tuning is done by moving the condenser handle over the scale of same) then the point of loudest signals as indicated on the condenser scale corresponds to 200 meters wave length, and this point should be noted.

This process is repeated about every ten degrees around the scale successively, and then all of the points and wave length equivalents are plotted on some square



Calibrating a Wavemeter.

ruled cross section paper and a smooth, symmetrical curve may be drawn through the points.

Relative to construction data for undamped wave receiving tikkers would say that a very good idea on same was published in the April, 1915, issue of this journal on page 228, and copy of same can be procured at 5c.

You will find a number of tables given showing increase in wave lengths when one or more wires are added on parallel to an aerial in any of the standard radio handbooks, such as those by Dr. J. A. Fleming.

LIGHTNING SWITCHES.

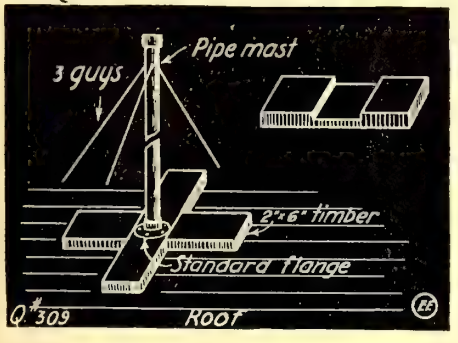
(308.) D. W. Vallow, Sebring, O., asks for data on lightning switch construction.

A. 1. The copper bar you mention will be all right for lightning switch construction and the moving blade should be 1 inch in width if it is ⅛ inch thick. The blade may be about 5 to 6 inches long and the whole may be mounted on a slate base or preferably on a marble base.

IRON PIPE MAST BASES.

(309.) Patrick J. L———, Boston, Mass., wants an idea on mounting the base of an iron pipe mast on gravel coated roof so as not to damage it.

A. 1. We suggest in the sketch a way in which to mount your small iron pipe mast on top of a roof, as you mention, so



Mounting Iron Pipe Aerial Mast on Roof.

as not to damage it. A common way to do this is as indicated in drawing, and the mast here has a substantial foot or base arranged under same, made of some fairly heavy timber, say 2 by 6-inch yellow pine.

If such a mast is properly guyed with about three guy wires, such as stranded galvanized guy cables, it will retain its posi-

Multi-Audi-Fone
The New Wonder in the Wireless World

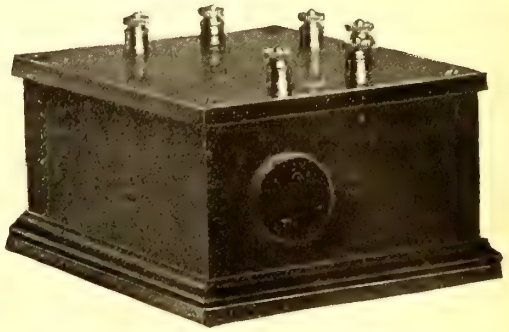
This instrument increases the audibility
ONE THOUSAND FIVE HUNDRED TIMES

Remember that the Multi-Audi-Fone will work equally well with all detectors, including the Audion, and when used with any wireless set will double and even triple the distance, and renders audible hundreds of stations that you can get in no other way, bringing out all nearby stations, as well as those thousands of miles away.

Price, $30.00

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The amplification is so great that when two Multi-Audi-Fones are used in tandem and a horn is attached to the receiver, the signals can be heard all over the five story building from our laboratories which are located on the third floor. If the windows are opened, the signals can be heard across the street, even when the trolley is passing.

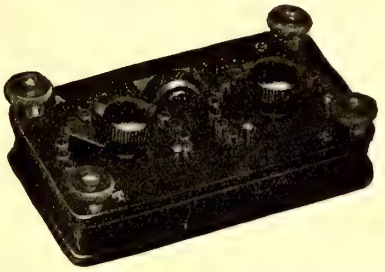


MULTI-AUDI-FONE

The exact measurements of this instrument are 4¼x3x2½ inches. Weight, 12 ounces

It increases the audibility one thousand five hundred times

MULTUM IN PARVO
(Much in Little)



The exact measurements of this instrument are 3¼x2x⅞ inches.

This instrument is indeed "much in little." It is a marvel of efficiency and campactness, for it combines the CRYSTALOI DETECTOR, which is superior to any other, with a COMPLETE AND PERFECT RECEIVER.

The Crystaloi Detector especially designed for us becomes far more sensitive when used in combination with our Multum in Parvo. This compact little instrument has a wave length ranging from 50 to 3,600 meters, and **will go into your vest pocket.**

Price, $20.00

These instruments in combination have a receiving range of 3,000 miles. They are beautifully finished in triple nickel plate and made of hard rubber composition.

One Hundred of These Outfits Sent On Free Trial

Naturally we must follow the rule of first come, first served. Therefore, if you do not get your outfit at once you will understand that there are others ahead of you and that you will get yours when your turn comes.

Offer to Radio Clubs or Others

We will send, at our own expense, one of these complete outfits to any radio club or any two persons. If you want to try this newest and greatest wireless improvement, sign the following letter. Have it guaranteed by your father or some other responsible man, and we will send the outfit to you on trial.

MULTI-AUDI-FONE: 273 Morris Ave., Elizabeth, N. J., 1915.

Gentlemen:—Please send us, at your expense, one of your complete outfits upon these conditions: First—We agree in no way to mar or injure any of the instruments by taking them apart. Second—We agree to repack carefully any of the instruments we do not buy in the same box in which we received them. The prices of these instruments are understood to be: Multi-Audi-Fone, $30; Multum in Parvo, $20. Head-Set, $5; the outfit, $55. Third—We agree to remit within ten days of receipt of the instruments for such of them as we decide to purchase and to repack the rest as above agreed, and return the same at your expense within ten days after they are received by us.

Very truly yours,

Two Signatures are required
No apparatus will be sent unless responsible person signs this Guarantee

(Name)..... Address.....

(Name)..... Address.....

I hereby guarantee that the above agreement will be faithfully kept and performed.

(Name)..... Address.....

SIGN—TEAR OFF—MAIL TO-DAY

Send For Our Circular. Correspondence Solicited.

MULTI-AUDI-FONE—273 Morris Avenue, Elizabeth, N. J.

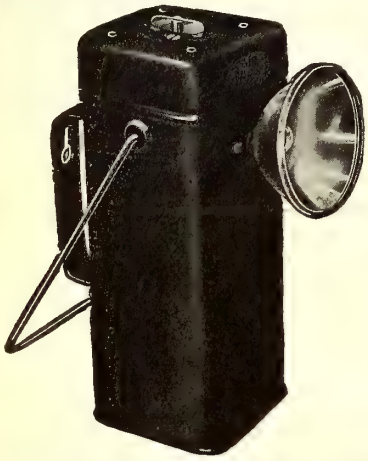
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FRANCO

SQUARE

HAS AN ADDED ADVANTAGE

Solidly built with double handles and equipped with the 3-volt Nitrogen Radio battery that produces the perfect range of light and gives three times the upkeep of any other standard six-inch battery that this lantern is made for.



Note the feature contact switch. Highly finished nickel or black enamel. Carried by all first-class dealers or write direct.

INTERSTATE ELECTRIC NOVELTY CO.

29-31 PARK PLACE, NEW YORK

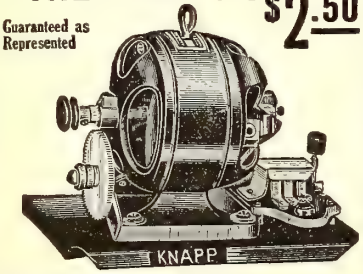
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BUILD A 3FT. CURTISS FLYING BOAT

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Formerly first, we are now last in aviation. You boys must make us first again. Study aeronautics, build a model man-carrying machine. We will send you plans. *Nieuport Monoplane* 25c. *Wright Biplane* 25c. *Curtiss Hydroplane* 35c. *Bleriot Monoplane* 15c. *Curtiss Flying Boat* 25c. *Cecil Peoli Racer* 25c.

Complete Set of Six — $1.25 postpaid.

Complete 48 page Catalog of "Ideal" Mode Aeroplanes and Supplies, 5c.

IDEAL AEROPLANE & SUPPLY CO., 76-82 W. Broadway, N. Y.

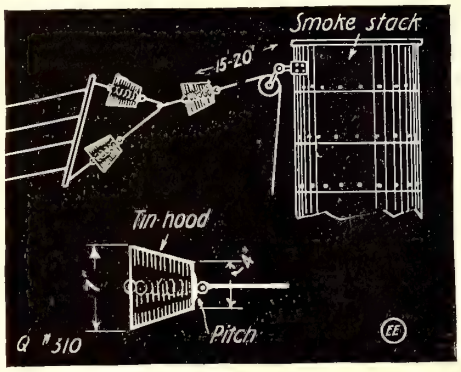
tion all right even in a high wind. Of course, the larger the base timbers are made the more stable the mast will be, and it should in no case be less than 4 to 5 feet in spread.

AERIALS ON SMOKE STACKS.

(310.) Ralph Liddle, Lake Benton, Minn., says he has facilities for erecting a good sized aerial on a steel smoke stack and wants our opinion on it.

A. 1. We might say that there are many wireless plants erected or installed under the conditions you mention, and iron smoke stacks are often used to support aerials very successfully.

It is well in such cases to leave quite a space between the stack and the spreader, say 15 to 20 feet or more, so that smoke or soot from the stack will not coat the spreader and its insulators, thereby providing a bad leak to the ground. It would be very advisable in such cases also to place a metal hood on one end of the insulator, as the sketch herewith shows, to keep the soot



Aerial Fastened to Steel Smokestack.

from the stack from falling on the insulator and destroying its high dielectric value.

A DEMAGNETIZING COIL.

(311) James McIntyre, Bridgeport, Conn., inquires for data on making a demagnetizing coil for machine tool work.

A. 1. Unless you have alternating current available you cannot arrange to use a demagnetizing coil in the way you suggest.

It is not practical to make any form of current reverser or commutator for use on 110 volts direct current, which we presume you use on magnetic chuck, of course, and hence you would probably have to use batteries with a small reverser or commutator, rotated by hand, etc., in series with the demagnetizing coil.

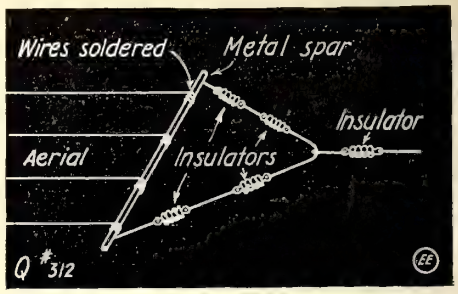
If you use 10 or 12 dry cells in series with a commutator or reverser, arranged for hand or motor drive, you could then use a demagnetizing coil consisting of about one pound of No. 18 insulated magnet wire wound into whatever shape you desire the coil to conform for your special requirements.

AERIAL INSULATOR ARRANGEMENT.

(312) Bertram E. Smith, Spring Valley, N. Y., shows two methods in his sketch of placing insulators in aerial spreader ropes, and wishes to know the best of the two schemes,

A. 1. The first method you show in diagram (here reproduced) of arranging four antenna insulators in series in the spreader supporting ropes is practically as good as any, and of course the more insulators you place in series the better the insulation in every way, as the resistance of such an arrangement is naturally higher.

It is quite common to use a metal pipe spreader in such a case, joining the aerial strands to the metal spreader and making sure that a good circuit is produced between it and the strands, etc., by soldering or other means.



Arrangement of Aerial Insulators.

IRON WIRE CIRCUITS.

(313) J. H. Emrick, Neopolis, O., inquires about iron wire resistance, etc.

A. 1. The 75-ohm Gernsback type relay will operate through circuits having 30 to 40 ohms resistance, and should operate in your case very nicely indeed.

The No. 12 iron wire of common E. B. B. grade has a resistance of 28.46 ohms per mile and "steel" grade wire has a resistance of 30.36 ohms per mile. This data is taken from the wire tables corresponding to the stock carried by the John A. Roebling's Sons' Co.

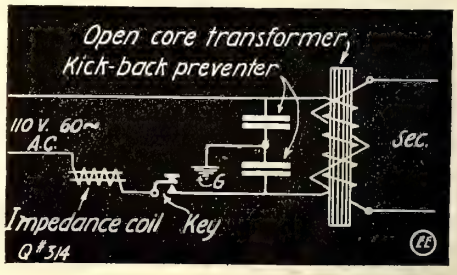
IMPEDANCE OR REACTANCE COILS.

(314) Thomas Robinson, Chicago, Ill., asks the meaning of "impedance" and "reactance" coils; also their connection in radio transformer circuits.

A. 1. The term "impedance" or "reactance" coil is used indiscriminately, generally speaking, and refers to a coil of wire usually provided with an iron core of laminated form and the coil to be used for controlling the amount of current passed through a circuit or for other purposes, such as choking back the high-frequency oscillations produced by radiophone arc generators, etc.

Diagram, as you request, is given herewith for the connection of open core transformer of wireless type, together with impedance coil in the primary circuit, for controlling the amount of current used.

It also has been found in practical radio



Kick-back Preventer and Open Core Transformer.

installations that such adjustable impedance coils in the primary transformer circuits can be used very efficiently to help tune the radio transmitting set, as regards the total resonance characteristics of the primary and secondary circuits of the transformer.

CONCERNING FILINGS COHERERS.

(315) George L. H—— wishes information on adjusting coherers for wireless sets, as he is having considerable trouble with such a set.

A. 1. Of course, coherer outfits have to be very finely adjusted in any case, and the Marconi coherer sets which were used

some years back were indeed very complicated and fitted with a great number of condensers, choke coils, shunt coils, resistances, etc., in order to make them work as nearly perfect as possible.

However, the Editor of this column has had a great deal of experience with coherer outfits, and can truthfully say that the *Electro* coherer which you have can do very good work indeed, considering its simple make-up. The coarseness and quality of the filings used in the coherer are of great importance, and you can experiment a little along this line to your own advantage, undoubtedly. A good mixture for these filings, and which, by the way, should be quite coarse, is that consisting of 85 per cent. steel grains and 15 per cent. silver. This mixture may be varied until best results are obtained.

The filings should never be touched by the fingers, as the oil of the skin will spoil the sensitivity of the grains. They should always be handled by a small piece of paper bent into a funnel shape or by means of a clean pair of tweezers.

The E. I. Co. 2-inch spark coil has about 50,000 turns of wire in the secondary and 150 turns in the primary. The No. 7,000 *Electro* Tesla transformer has about 30 turns in the primary and 1,000 turns in the secondary.

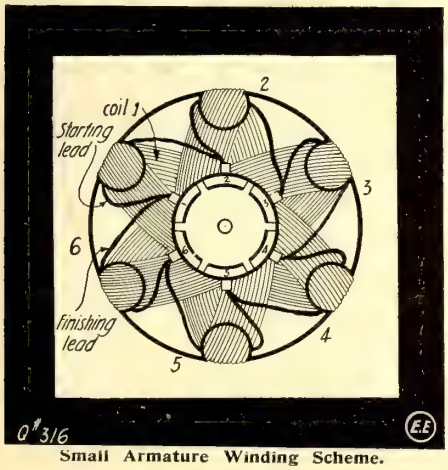
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(316) Ervin R. Musgrave, French N. M., asks several questions regarding armature winding, storage battery plate design, etc.

A. 1. Diagram is given showing how the winding on the type SS dynamo armature is carried out. Six coils are wound on same, overlapping each other, while the leads from the coils are consecutively joined to the commutator segments as indicated.

In rewinding the armature on your telephone generator about No. 22 insulated magnet wire should be wound on same until it is solid and also quite full. A two-segment commutator must be used if the machine is to give direct current, so as to operate small battery motors, etc.

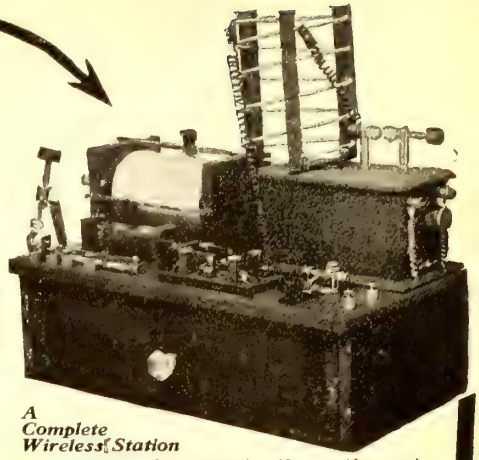
In regard to the design of the storage batteries and the allowance made in the size of the plates with respect to the ampere-hour capacity, the standard American rule is to allow 50 ampere-hours capacity for every square foot of positive plate surface. It should be borne in mind that invariably the positive plate surface is figured as the length times the height of the plate multiplied by 2, as this plate in most cases is placed between two negative plates, and hence both sides are active in the action of the battery.



Small Armature Winding Scheme.

The standard design of such lead batteries covers the use of practically in all cases one more negative plate than there

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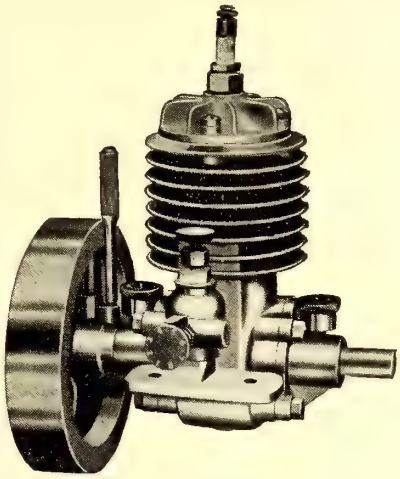
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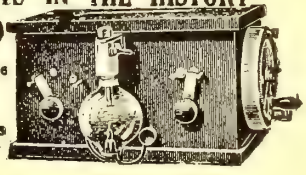
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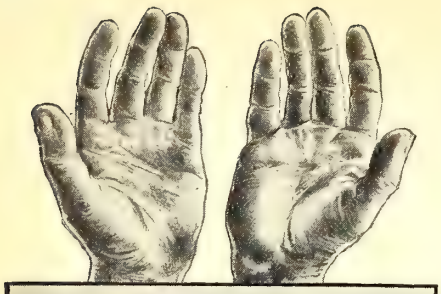
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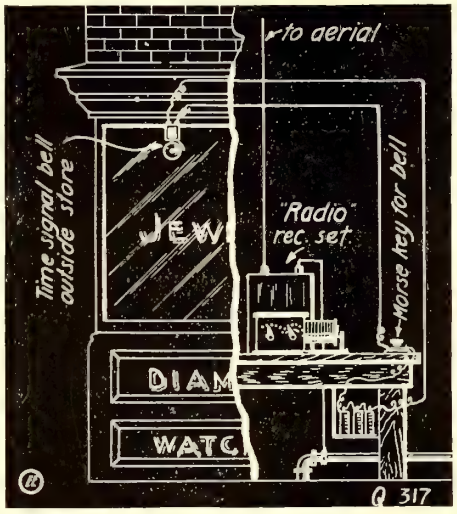
are positive plates in the cell to help as much as possible an equal electro-chemical action in the positive plate to prevent its "buckling," which tends to be the case when a negative plate faces but one side of the positive plate, instead of both sides. Also the positive plates are considerably more active electro-chemically than the negative plates, but they do not last as long, generally speaking, tending to disintegrate more quickly than the negatives.

For further data in this direction we refer you to either the Standard Hand-book for Electrical Engineers, price $5, or Storage Battery Engineering, by Mr. Lamar Lynden, worth $3. These books are procurable from our book department.

RADIO TIME SIGNALS FOR THE PUBLIC.

(317) O. A. Duppstadt, Vadergrift, Pa., wants to make the wireless time signals audible to the public outside his store.

A. 1. Some jewelers arrange this matter by having a duplicate set of head 'phones available, which those interested may try on and so listen to the "time signals" coming in, and also some utilize a "bell" outside the store, connected with a Morse tele-



Electric Bell Signal for Radio Time Signals.

graph key at the radio operating table. As the time signal dots come in on the head 'phones the key is pressed each time, thereby giving bell signals outside of the store for the guidance of the public.

Needless to say, the bell must be arranged with respect to the wireless receiving instruments so that it does not interfere acoustically. This can be accomplished by placing the wireless set in a small booth, such as a telephone booth, if necessary.

STATIC MACHINES IN PARALLEL.

(318) A. J. Boldizer, Gallitzin, Pa., is interested in the parallel operation of static machines.

A. 1. We have never tried running static machines in parallel or in series, but but owing to the practical impossibility of synchronizing the discharges of these machines of the ordinary type, it does not seem practical to attempt such work. With special machines it may be possible.

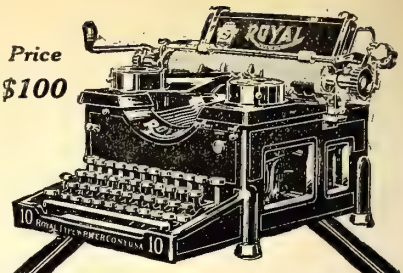
You will find data given in Nikola Tesla's book, at $1 prepaid, entitled "Experiments with Currents of High Potential and Frequency," on an arrangement whereby static machine discharges can be faithfully duplicated by means of high-frequency transformers and condensers, etc.

Briefly stated, the apparatus is arranged as follows:

G is an ordinarily constructed alternator,

(*Continue on page* 233.)

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PATENT ADVICE

Edited by H. GERNSBACK

In this Department we will publish such matter as is of interest to inventors and particularly to those who are in doubt as to certain Patent Phases. Questions addressed to "Patent Advice" cannot be answered by mail. Sketches and descriptions must be clear and explicit. Only one side of sheet should be written on.

CAN A. C. TO D. C. MECHANICAL CONVERTER BE PATENTED?

(10) Phil D. Strong, Linwood Farm, Ia., sends in a description of a mechanical device to change alternating current to direct current.

His invention is accomplished by rotating shaft and a commutator, and the correspondent desires to know if it is an original invention and of any practical use.

(A.) Schemes of this sort have been used for quite a while back, and we remember a stage act where the performer converted alternating current to direct current by very similar means, but he used some very large specially arranged commutators for the purpose. The trouble with commutator devices of this kind is that there is too much sparking, and as a rule a much simpler means is provided to-day in chemical or vibrating rectifiers, neither of which spark as much as a commutator device.

While the rotary converters are based on a similar plan to that outlined by our correspondent, there are several phases that enter into their manufacture that make it quite a little different.

We do not think that a patent could be obtained on the device of our correspondent.

ROYALTY ON IMPROVED PATENTS.

(11) James J. Connolly, of New York, writes as follows: "If A invents an article and has it patented, B buys one of these articles and improves on it and has his improvement patented, must B pay A a royalty to manufacture A's article with B's improvement?"

(A.) In regard to the above we offer the following explanation:

It all depends what the invention is. If the improvement of B so changes the article invented by A that he makes a new article of it, then B does not have to pay a royalty to A.

If, on the other hand, the improvement of B is only an addition to the basic invention of A, then in that case B certainly must pay a royalty.

Cases of this kind are usually handled in this manner:

If A has an article on the market and B improves upon it in such a manner that it will make the article more valuable than the original one manufactured by A, it will usually be found that B sells his invention to A; and in an extreme case A allows B to manufacture it, having B pay a royalty on the article.

From the above it will be seen that it all depends on the nature of the invention or improvement, and it is impossible to give further advice without knowing the details.

MORE DETECTOR PATENTS.

(12) W. B., of Uniontown, Conn., wants to know if he could patent a galena detector stand, using two phosphor-bronze wire contacts instead of one.

(A.) We have repeatedly stated that small constructional details in any apparatus do not afford the inventor, even if he could obtain a patent (which is doubtful) any protection. We would discourage all inventors from trying to patent articles which only show small improvements on the article and which do not show distinct material changes. Patents of this class are termed "improvement patents" and as a rule are not worth much, as anyone can easily go around the few claims and substitute another device, which usually works just as well or better.

Even very strong patents which have a great many claims and are quite original are often improved upon or their claims are simply evaded, and it is almost hopeless to patent anything that is not quite original.

We desire to cite a point in case.

About a year ago there was invented by a New York inventor a flashlight in the form of a fountain pen. The patent in this case was the "clip contact" of the flashlight, which "clip" made contact to light the flashlight and at the same time was used to hold the flashlight in one's pocket similar to an ordinary fountain pen. Up to this time of writing some six flashlights are in the market, all having the same feature as stated above, and not one of them really infringing on the original patent. The newer construction simply evaded the original patent by changing the construction slightly, and the original owners are powerless to prosecute, for their original patent does not cover the later designs.

From the above it will be seen that if an inventor has an article which he thinks a really good one, he should try and *cover himself* as thoroughly as possible by submitting to his patent attorney as many variations as are anywhere practical, in order to afford full protection.

REGARDING FOREIGN PATENTS.

(13) Elmer B. Garey, Pittsburgh, Pa., wants to know in what other countries besides the United States a patent should be applied for on an important invention.

(A.) This is really a case for a patent attorney, and without knowing what the invention is it is almost hopeless to give any information. It depends entirely what the article is to be used for and which country it would interest most.

Offhand, we would say that if the patent is important patents should by all means be obtained in the following countries. We also append the cost of patents in the various countries:

Australia	$120.00
Canada	87.50
France	96.00
Germany	113.50
Great Britain	82.00
Japan	120.00
Russia	142.50

Of course there are a great many other countries in which patent protection would quite possibly benefit you, and we advise that you should take up this matter with a competent patent attorney for your own protection.

PATENTING LOUD TALKING TELEPHONES.

(14) Alfred B. Lewis, Chicago, Ill., has invented a loud-talking attachment for the ordinary Bell telephone, the idea being that the ordinary receiver will talk loud enough to be heard in the room. He wants to

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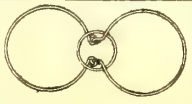
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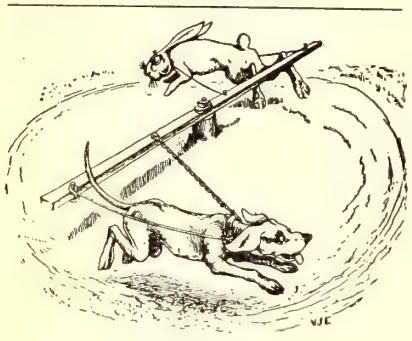
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know if such an invention is practical and whether a patent should be obtained.

(A.) There have been invented quite a few of these devices which usually are merely "acoustic" attachments to the receiver. While in some cases such an attachment may be used, there is really not much practical use for same in the average business office. Most people would certainly not have any use for such a device, as the receiver in its present state of development talks loud enough. Again, most business men would strenuously object to such a device, as they do not wish others to know what is going on over the wire.

While there are of course uses for loud talkers, we would discourage inventions in this line, as they are not of a widely useful nature.

One-Magnet Bells.

(15) E. B. Miller, Newark, N. J., has sent us a model of an electric bell, which, instead of two electro magnets, has only one, but an iron return circuit is provided to obtain a good magnetic efficiency. He wishes to know if a device of this kind is patentable.

A. There have been quite a few of these bells on the market in the past, and while to the best of our knowledge none are manufactured in this country now, there are several German firms who make a very cheap bell and in order to save manufacturing cost provide only one magnet. These bells, however, are not looked upon favorably by the trade, although they are quite cheap. Inasmuch as bells of this kind have been on the market quite a while back, we are quite sure that no patent can be obtained on such a device.

Collapsible Aerial Mast.

(16) H. Forsythe, Elizabeth, N. J., has submitted a drawing of a portable collapsible wireless mast, and wishes to know if the design is practical and whether a patent can be obtained upon it.

A. We have come to the conclusion that the idea is a very good one; we have never to our mind seen anything like it, and from the records obtained in our office, we have concluded that a mast of this kind can be patented. There should be quite a demand for such an article as there is none on the market now, and we would advise you to get in touch with a patent attorney to prosecute your invention. We think it is worth patenting.

What to Invent?

(17) Sylvian McNast, San Diego, Cal., writes us as follows: I have a lot of time on my hands and am very handy with tools, also know a good deal about electricity. I am of an inventive turn of mind and think that if I had a list of articles that are worth while inventing I could perhaps make a success with one of them. Will you be kind enough to publish a list of inventions that are necessary and wanted just now?

A. We have not the space at our disposal to publish a list showing what things to invent as such a list is necessarily very large and at best is incomplete. However, we understand that several of the patent attorneys are printing comprehensive booklets giving lists of articles and objects which await patenting and should net their inventors considerable sums.

We advise you to write to the patent attorneys whom you will find in our advertising columns and we are sure that you will find a lot of food for thought in their literature.

"Financial" Advice.

(18) A. M. S., Peoria, Ill., says he has made an invention which his attorney advises him to patent, but he lacks the funds to obtain a patent and asks our advice what to do in a case of this kind.

A. Cases of this kind are very common indeed, and the only thing to do is to show the invention to some friend or friends in whom you have sufficient confidence and induce them to either loan you the money, or, if this cannot be effected, induce them to share the profits of the invention by selling them an interest in the patent when same is issued by the Patent Office. The latter is, perhaps, the better advice, particularly if you can find someone who thinks well of the invention.

RADIO-AMATEURS JOIN IN RELAY LEAGUE FOR WAR WORK.

Should Uncle Sam ever go to war, he will have to thank a group of young New England amateur radio-experts not only for helping establish the most comprehensive auxiliary wireless system of any country in the world, but also for a rivalry among the thousands of United States amateur workers that could be used to reinforce many times the present wireless network of the country at a minute's notice.

In connection with the formation of the American Radio Relay League by Hiram Percy Maxim of Hartford, ten special amateur licenses have been granted in the New England district, upon recommendation of Henry C. Gawley, the government radio inspector here. Without exception every one of the remaining 700 active amateurs in the district are now seeking to secure the coveted privilege of heading a special relay station such as the special amateur license permits. Thousands of young amateurs in districts all over the United States are seeking the same coveted honor.

Wireless messages under the special permit can be relayed as far as Chicago and even farther West.

The ten lucky New England men are permitted for relay purposes to use a 425 metre wave length, while the general amateur is restricted to a 200 wave length.

Each special license amateur is closely investigated by Inspector Gawley, reported as possessing an A1 equipment and receives his permit direct from Secretary Redfield of the United States Bureau of Commerce at Washington. He is also designated with a special call letter.

His appointment is specially significant since Uncle Sam grants a special license only after having made sure that the recipient will materially benefit his wireless service.

Mr. Gawley, in discussing the new relay chain, said:

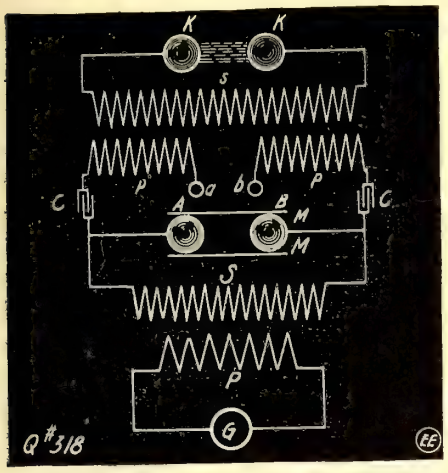
"The League will be of immense help in case of war. It adds to my duties, but on the other hand it brings me into much closer touch with the special amateurs and helps to perfect the government's control over all the wireless amateurs in the league.

"The permits are granted only from year to year. The special license assures us of an active station. If it is not active a license renewal will not be granted. In this way the entire wireless field is carefully guarded. The league members can relay messages from Coast to Coast, and, in fact, to all parts of the country, the maximum distance being about 400 miles.

QUESTION DEPARTMENT.

(*Continued from page 230.*)

supplying the primary P of an induction coil, the secondary S of which charges the condensers or jars C C. The terminals of the secondary are connected to the inside coatings of the jars, the outer coatings being connected to the ends of the primary



Imitating a Static Machine Spark with High Frequency Coils.

p p of a second induction coil. This primary p p has a small air gap a b.

The secondary s of this coil is provided with knobs or spheres K K of the proper size and set at a distance suitable for the experiment.

A long arc is established between the terminals A B of the first induction coil. M M are the mica plates.

Each time the arc is broken between A and B the jars are quickly charged and discharged through the primary p p, producing a snapping spark between the knobs K K. Upon the arc forming between A and B the potentials fall, and the jars cannot be charged to such high potential as to break through the air gap a b until the arc is again broken by the draught.

In this manner sudden impulses, at long intervals, are produced in the primary p p, which in the secondary s give a corresponding number of impulses of great intensity. If the secondary knobs or spheres K K are of the proper size the sparks show much resemblance to those of a Holtz static machine.

A. 2. A sinusoidal current is merely an alternating current which changes from positive to negative many times a second, and having a symmetrical wave form.

TELEGRAPHONE QUERY.

(319) J. W. Arnold, Little Rock, Ark., asks how many times the steel wire in the telegraphone may be used to record messages on, or if it can only be used once.

A. 1. The arrangement you speak of will probably work out very well for use in conjunction with the telegraphone. The steel wire used in the telegraphone is, of course, used over and over again, and the "talk" registered on same magnetically is obliterated or removed by simply reversing the wire through the machine and bringing in close proximity to the moving wire a steel horseshoe magnet, which demagnetizes the wire so far as the message on it is concerned. In the commercial machines an electro-magnet is generally used for the purpose.

HIGH VOLTAGE RECTIFIERS.

(320) W. C. Ewing, Fayetteville, N. C., wants to know if an electrolytic rectifier such as the E. I. Co. build, can be used

(*Continued on page 234.*)

DOCTOR GIVES AID VIA WIRELESS.

The wireless invention has again proven its value. Capt. Lane, of the steamship "Bradford," arrived at Philadelphia from Tuxpan, Mexico, and tells a story that on the second day out a sailor was taken ill. No physician being on board the wireless operator swept the sea with his wireless in search of one. A British warship answered, but refused to give her location, and said she could not leave her post. The man's symptoms were wirelessed to the ship's doctor, who diagnosed the case as pneumonia. The physician then wirelessed a prescription to Capt. Lane.

AIRMEN ADD TWO TO NAVY BOARD OF INVENTORS.

The nomination by the Aeronautical Society, at the request of Secretary Daniels, of Hudson Maxim and Matthew B. Sellars for members of the Naval Advisory Board on Invention brings the membership of the board up to seven, the other members being Thomas A. Edison, Alexander Graham Bell, Orville Wright, Henry Ford and Charles P. Steinmetz.

The Aeronautical Society is the first of the various engineering and scientific societies to respond to Secretary Daniels's request that they nominate from their membership for places on the board.

This Splendid

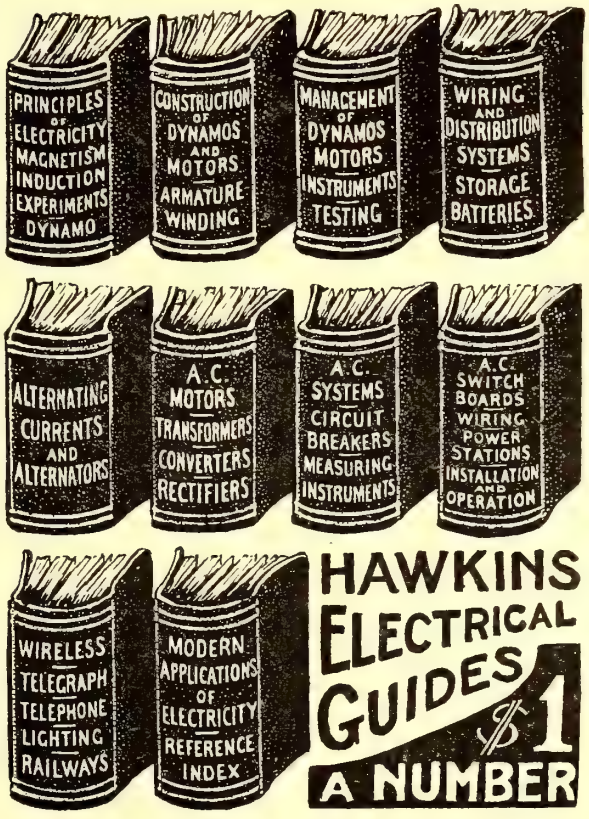
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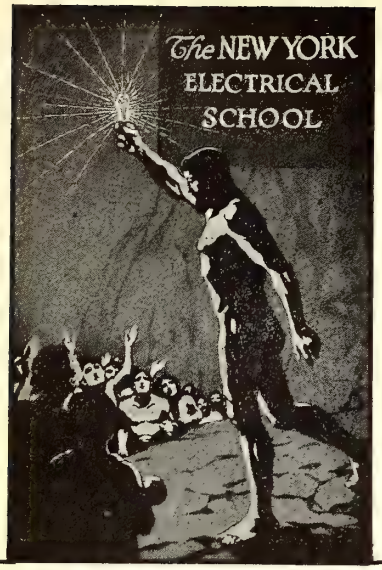
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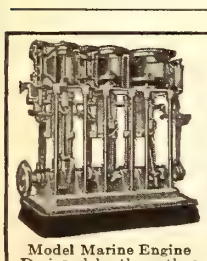
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for rectifying high-voltage alternating current, such as 90,000 volts.

A. 1. We believe that special apparatus working on the vacuum tube principle probably can be furnished by the General Electric Co., Schenectady, N. Y., to produce high-voltage direct current in the form of a static charge for the purpose you have in mind. Its Kenotron rectifier tubes, for high alternating-current voltages, should be all right for your work.

WILL INDUCTION COILS OPERATE ARC LAMPS?

(321) A. L. W———, Isle of Pines, W. I., speaks of using an induction coil for operating arc lamps.

A. 1. Induction coils cannot be used to operate arc lamps or other such apparatus, owing to the high voltage of the current and to the low amperage of same, and to the fact that this secondary current is an unsymmetrical one of irregular frequency with many long "dead" time periods. Induction coils may be made with any voltage ratio existing between primary and secondary windings desired.

The voltage ratio is primarily dependent upon the number of turns in the secondary coil compared to those in the primary coil. For instance, a secondary coil composed of 500 turns would give an increase of twice the primary voltage if the primary winding comprised 250 turns of wire, and vice versa.

UNBALANCED 3-PHASE A. C. SYSTEM AND WIRELESS RECEIVING.

(322) Barney Lawson, Houston, Tex., inquires about an "attic" indoor type aerial he has erected, and wonders if it would pass the Fire Underwriters' inspection.

A. 1. The aerial you mention would most probably be all right from the electrical and Fire Underwriters' point. We would strongly suggest, though, that with such indoor aerials lightning rods be placed on the exterior of the roof of the house.

If you employ an "L" shaped aerial it is best to connect the lead-in to one end of same.

We do not believe that any unbalancing of the three-phase system you speak of would materially affect the wireless receiving apparatus, so far as can be judged without knowing exact details as to the relative position and location of all of the apparatus, its wiring and nearby alternating-current circuits, etc.

TRANSFORMER DATA BOOKS.

(323) Dr. C. C. W———, Buffalo, N. Y., desires transformer construction data and books bearing on the subject.

A. 1. The data you desire, generally speaking, is given in Mr. Curtis' excellent 25-cent book entitled "Construction of Induction Coils and Transformers."

Another excellent work which will be of great service to you in this direction and containing data for all sizes of wireless transformers up to 5 kw., given in considerable detail with tables, etc., is the work known as "Wireless Telegraphy and High Frequency Currents," by Prof. La V. Twining. Our book department can furnish this book at $1.50 prepaid; also the book by Mr. Curtis.

The method of calculating the secondary and primary windings is thoroughly explained in this book by Professor Twining, as well as a host of other problems in this direction.

RADIO SIGNALS NOT CONSTANT.

(324) A. B. Rowland, Stuttgart, Ark., complains that incoming wireless signals at his station have for a year or more tended to start off strong and then faded away. He has been unable to locate any faulty circuits.

A. 1. The conditions you mention in your wireless station are common, and in most cases that we have investigated of this nature it has usually been found that the trouble is due to a loose or faulty connection at some point.

In one case it was found to be due to a swinging loose joint in an aerial lead-in wire. Sometimes this swinging joint, which was not a perfect one, would open the circuit, so far as the reception of wireless signals was concerned.

We have looked over your query carefully and would suggest in closing that you very carefully examine every piece of apparatus in your set, and especially the binding posts, etc., to see that they are firmly tightened up. Changing sensitivity in the detector is sometimes the cause of this trouble (check this by throw-over switch and two detectors), and a swinging aerial can cause this phenomenon. Atmospheric electric charge variations possibly have some effect.

REGARDING DR. COHEN'S NEW NAVY RECEIVING SET.

(325) Spencer Hass, Kankakee, Ill., asks several questions about Dr. Cohen's new navy type radio receiving set.

A. 1. Relative to the article published in *The Electrical Experimenter* for July,

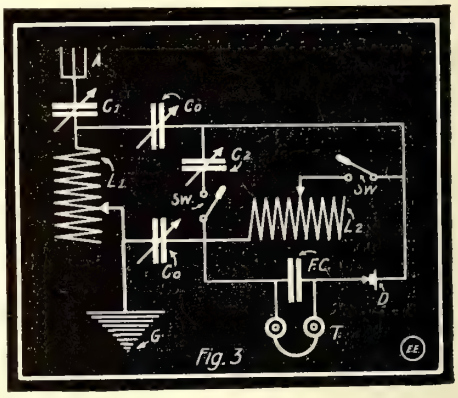


Diagram of Dr. Cohen's Improved Navy Type Receiving Set.

1915, on "Dr. Cohen's New Navy Type Wireless Receiving Set": The inductances L^1 and L^2 are in the form of tuning coils, as you suggest. These may be of different sizes, depending upon the wave length values required for the circuits. Several of our readers have communicated with us, stating that they have found this system very fine indeed, and much superior to anything they had ever tried heretofore.

The purpose of the two switches in the tuning circuits is to enable the inductance L^2 or the variable condenser C^2 to be cut out when tuning this set to different wave lengths. When inductance L^2 is cut out of circuit the path of the oscillations is through inductance L^1, around the circuit through condenser, say C O, to the detector D, thence thru fixed condenser F C and on through the second variable condenser C O back to inductance L^1.

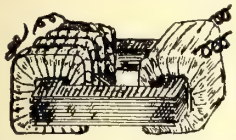
When inductance L^2 is in use in the circuit, then the oscillations are tuned through L^1, two variable condensers C O, and C O and inductance L^2.

The set works similar to an ordinary wave meter, and the detector and fixed condenser F C, with 'phones across it at T, simply act to detect when maximum resonance takes place in the closed oscillatory circuit just mentioned.

The vertical and horizontal wires just below the condenser C^2 are joined as you

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It will throw a heavy, crackling spark that with proper condensers will fill a gap with a ball of fire almost 1-4 in. in diameter.

This heavy spark will send six (6) times as far as 1 in. spark coil.

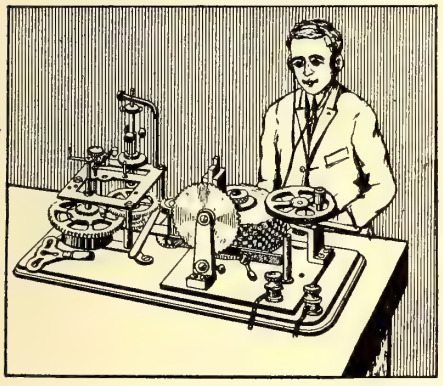
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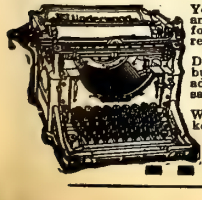


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mention. The variable condensers may have a capacity of any ordinary value, and of course this depends upon the wave length to which the set is tuned. An ordinary value for same would be .001 M. F., and larger condensers may be used, giving greater wave-length capacity.

CHANGING SERIES DYNAMO TO SHUNT.

(326) J. D. Dalney, Dallas, Tex., has a small dynamo which he wishes to convert from series to shunt-wound type, i. e., with the field winding hooked across the armature brushes.

A. 1. You will undoubtedly have to rewind the field of your machine of the series type if you desire to convert it into a shunt-wound machine.

Generally speaking, the field coils should be rewound with magnet wire about 4 to 5 sizes smaller in circular mils area than the wire at present in use for the series field. About the same amount of wire should be used as regards weight, or also a proportionately greater amount of turns should be placed in the coils.

ELECTROLYTE DENSITY FOR INTERRUPTERS.

(327) H. Bennett, Clarinda, Ia., wants to know the specific gravity of electrolytic interrupter solution.

A. 1. In regard to the solution used in the Gernsback electrolytic interrupter, would say that sulphuric acid only has to be added every couple of months or so.

The specific gravity, if measured by a hydrometer, should register about 1,210 degrees.

The solution in the interrupter is kept up to its proper level by the addition of pure water from time to time as necessitated by the evaporation of the water in the solution.

A NEW DRY CELL SEARCHLIGHT.

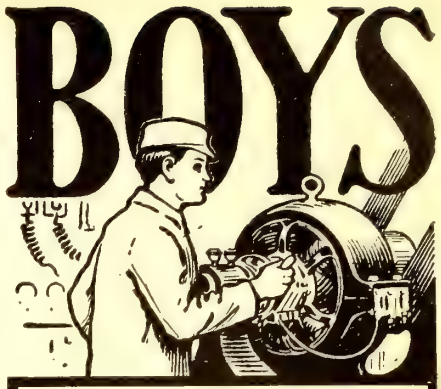
There are numerous uses for a vehicle searchlight that may be operated successfully from dry cell batteries. The new Pittsburgh searchlight, illustrated herewith, employs a powerful focusing lens in connection with an 8-inch parabolic reflector, which produces a beam of light with ample power for automobile and motor boat use. The current consumption is only one ampere (thus making the ordinary dry cell battery an economical source of current supply). The bulb is a 6-volt Mazda, and the lamp can therefore be used with any 6-volt lighting system, or with ordinary dry cells. For automobile use it may be mounted on the door or wind shield. It not only serves as a searchlight for reading signboards, turning and backing, but answers the purpose also of an auxiliary headlight for use in emergency cases. It gives the gaslighted car the use of an electric light whenever needed.



New Auto Lamp—Works on Dry Cells.

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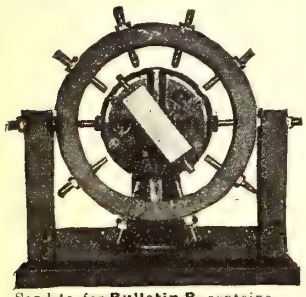
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THE WONDERS OF RADIUM.

(*Continued from page* 183.)

Upon focusing the lenses and upon looking through them, one will see that the screen is continually giving forth small sparks, which as the Radium salt is brought closer to the screen, increases the brilliancy and frequency. A beautiful scintillating effect is obtained, impossible to describe. In our Fig. 10 we see a magnified view of the lighting up of the screen on the inside of the Spinthariscope, one-half of the screen having been covered up.

Our Fig. 11 shows a very enlarged view of the inside of the Spinthariscope, but it does not adequately show the beautiful color effects obtained with this instrument. It goes, of course, without saying that there is nothing to wear out in this instrument and it will last as long as the speck of Radium will last, i. e., 2,500 years and longer. It was with this instrument that Crookes demonstrated that the emanation of Radium consisted of millions of positively charged atoms hurled off from the Radium salt with terrific velocity, and it is this which causes the particles of the zinc sulphide to sparkle and glow.

We have stated elsewhere that Radium is capable of giving off a tremendous amount of heat. Indeed, this shows us a way where future man will smile when he reflects how we used coal to-day, which gives but 5 per cent. of its actual energy when translated into steam, the rest being carried off as waste heat. The future man will, no doubt, laugh at the idea of how we had been using **6,000 tons of coal** for a single trip (costing some $12,000, valuing coal at $2 per ton, which is very cheap), to propel a modern steamship like the "Mauretania" across the ocean, with the accompanying vast amount of space required in which to store these 6,000 tons of coal. Not only this, but he also will undoubtedly smile when he contemplates the very cumbersome machinery necessary in order to transform the latent energy in the coal into steam, when his amazement will be even greater.

It has been found that when burning one gram of coal that only about 8,000 calories of heat are obtained. In this change, however, 2⅔ grams of oxygen are consumed, so that per gram of the two compound substances we only get 2,200 calories of actual heat. This combustion is instantaneous. It must be renewed all the time, as coal will, of course, burn up very fast. If we now substitute Radium for coal we find that one gram of Radium develops 133 calories of heat per hour. There are 8,760 hours in the year; therefore, figuring on this basis, a gram of Radium will net us about 1,160,000 calories during the course of the year. In one year 1/2500 part of the Radium changes. Thus, during the complete change of one gram of Radium no less than 2,900,000,000 calories would be evolved in 2,500 years.

Considering this basis of energy transformation, the power latent in Radium is well over a million times greater than that furnished by the combustion of coal. This gives us a good idea of the tremendous power of the mysterious element—Radium.

To continue, with regard to driving a modern ocean greyhound across the sea by means of Radium instead of coal, the illustration at Fig. 12 will be of interest. This shows fairly well the small amount of space consumed by the Radium boiler which would undoubtedly be used on board the steamship.

Getting down to actual figures, we have seen that 6,000 tons of coal used for such steamships as the "Mauretania" would cost, let us say, on the average $12,000. It has been calculated that to give forth the same equivalent of energy for one trip of the steamship would necessitate the employment of .15 (fifteen-hundredths) of a gram of this precious substance, which is worth $96,000 per gram, according to the market figures which have prevailed previously. Thus the .15 gram of Radium (and considering that all of the energy in this fraction of a gram of Radium could be liberated during the five days' run of the steamship) would cost .15 of $96,000, or $14,400 This is a little higher than the cost of the coal, but it should not be forgotten for one moment that this Radium here proposed for propelling the steamship would only weigh the fraction of a gram, and there being 28.35 grams to the ounce, avoirdupois. Also the 6,000 tons of coal here involved would weigh 5,448,000,000 grams; or in other words, the coal necessary to be carried on board the steamship for a single trip would weigh approximately 35 billion times more than the total weight of Radium necessary. Again, and considering the new Government rate* just made effective for the reduced cost of Radium, which is one-third the old market price, the actual cost of the .15 gram of Radium would be $4,800. This does not even begin to mention the valuable space taken up by the ponderous machinery, boilers, bunkers for the coal etc., which with the Radium would, of course, fall away entirely. The only machinery necessary would be a small boiler with water, a turbine engine and the speck of Radium. Our arrangement as shown at Fig. 13 could, of course, be used with modifications.

It consists of a boiler of spherical form having a radius of several feet and a small shell of iron, with the Radium hung in the center of the boiler, as shown. Such a boiler would, of course, take up but a very small space, and is readily installed. The energy supplied by the Radium is distributed equally in all directions, and therefore the heating of the water in every part of the boiler is practically equal.

Submarines could be easily propelled with this wonderful substance, which naturally would replace cumbersome oil engines, thereby preventing accidents from explosions and also the danger from fumes given off by storage batteries during the period when the vessel is submerged.

An interesting illustration of the marvelous power or rather of the inherent energy in Radium is shown in our Fig. 14. It seems incredible that such a ponderous structure as *the Woolworth building, weighing* 103,000 *tons, could be lifted by means of the energy evolved from* 1/50 *gram of Radium.* Nevertheless this is a fact. It has been shown that .0225 gram of Radium, costing $2,160, if caused to act through its normal life of 2,500 years continuously on a powerful electro-magnet, would furnish enough energy to lift the Woolworth building one foot above the ground, as shown in our illustration. Of course the illustration which we offer is only made to convey the idea graphically and is not in reality complete, for it would be necessary to first transform and store the electrical energy of Radium into a charging plant, such as a monster storage battery, charging this storage battery for a period of 2,500 years without interruption. At the end of this period we would have (theoretically) accumulated enough energy to actuate the immense magnet and for a few moments there would be enough energy at hand in our storage battery to lift the Woolworth building clear. In other words, we would

*As we go to press the Government announces that it has succeeded in producing Radium at a cost of $36,050 a gram, which is exactly one-third of the cost it was heretofore. This Radium is now produced from our Cornotite mines in California and Colorado.

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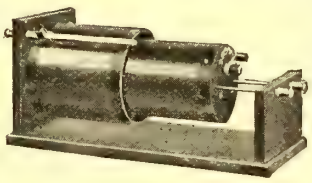
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have obtained enough power for a few moments to lift 103,000 tons one foot above the earth! And 1/50 gram of Radium accomplished it!

While the above example clearly demonstrates the tremendous inherent power that lies dormant in Radium, there are, of course, thousands of other applications which could be successfully worked for the benefit of man.

Verily, we have no conception of the marvels that lie buried in the future!

WIRELESS AND THE CLERGY.

A wireless dispatch of 80 words is being sent by the Canadian Government to the clergy on the Magdalen Islands in the Gulf of St. Lawrence, to be read from the pulpits each Sunday morning in order that the inhabitants, who are shut off from the outside world, may know of the progress of the war.

OMEGON.

(*Continued from page* 190.)

"It took two men to carry out wan of thim sleepin' kids, an' after a couple of trips they'd go to sleep thimselves. The ship's engines stopped an' th' second engineer—th' last man awake in th' engine room—a brown, wild-eyed little divil, crawled out an' hugged a stanchion close to me. Thin he slid down like a strip of liver an' closed his eyes.

"Thin th' Japs lowered their flag, an' soon after—hivin bless yez, Cawthorne,—th' flags of three other ships came down."

Ned stepped close, grasped the captain by both shoulders, and demanded: "The other boats, Mulray! Did you see anything of them?"

"Divil a——" But he was interrupted by the surgeon.

"A message has just come in from Gualala, Mr. Cawthorne. Your five submarines are there, and all well. They've put the enemy's flagship and four others out of commission and you haven't lost a man. I don't know what those boats cost you, but——"

Ned interrupted with a grin: "They cost, covering everything, less than three hundred thousand. That's outside of the *Sarah Q*. She's good value yet, and I've got some new work to put her at."

"Three hundred thousand!" gasped the surgeon. "And those five superdreadnaughts didn't cost less than fifty millions before they left the yards!"

That evening Cawthorne and the men who had operated the submarines with him supped together hilariously in the cabin of the *Sarah Q*. She was steaming back to San Francisco, the little boats in tow. As they lit cigars and pipes, Ned slipped a handful of checks into Kilroth's hand.

"Boys, I am sending round to you at once your checks for two thousand dollars, as I agreed. That's about a thousand an hour for this little adventure."

After the howl of delight subsided he went on:

"The Admiral has requested me to turn the submarines over to him to use against the southern squadron of the enemy, now making for San Francisco. I have agreed to do that; and he wants the crews also. That's up to you."

A roar of cheers greeted this statement. Captain Mulray sprang to his feet and shouted:

"We're yours, Cawthorne, hearts, souls an' bodies! Just you lead th' way, an' iv'ry damn Jap or Chinese dreadnaught on th' Pacific'll get th' Omegon paralysis!"

Cawthorne laughed and shook his head. "Can't do it, boys! You can handle the navy all right, but there's an army of the enemy getting ready to cross the Rio Grande. Submarines won't work there, so Kilroth and I are going to put a new round-up device in commission. We'll be ready for your help as soon as you're through with this other little Omegonizing job."

THE END.

ELECTRICAL SHIP PROPULSION.

If the electrical propulsion of a vessel of the United States navy seems a roundabout method of using the energy of steam, the results of a late Swedish experiment show that it should be far from wasteful. The "Mjolner" and the "Mimer" are sister steamers of 2,225 tons displacement each, the former being driven by electric motors fed by steam-turbine generators, while the second boat is fitted with ordinary triple-expansion engines. It was stipulated that, while each vessel should have a speed of 11 knots with engines developing 900

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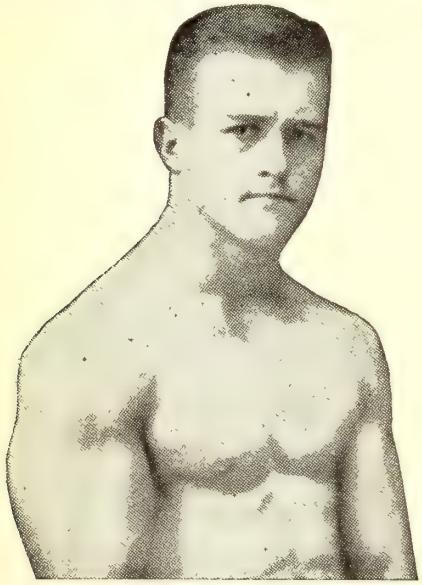
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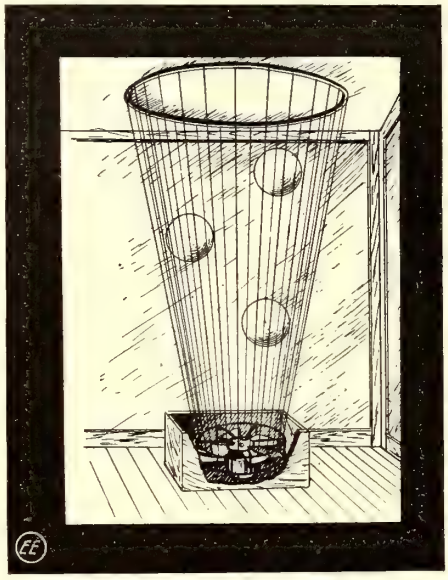
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horse-power, the turbo-electrical vessel should use 30 per cent. less fuel than the other. In the trial trip of seven hours, the guaranty for the turbo-electrical vessel was much exceeded, for the engine developed 975 horse-power, the average speed was 11.8 knots, and the saving in coal consumption reached 35 per cent. The steamers are to be used in Swedish coast trade.

SHOW-WINDOW ATTRACTION.

A moving thing in a window is reasonably sure to get a crowd, and it is easy for an electrical dealer to have motion in the windows, says *The Electrical Dealer and Contractor,* and a very good means of providing motion in a window is by means of an electric fan, a small box and a lot of twine. This is illustrated herewith.



Effective Show-Window Attraction—Fan Blows Balloons Upward Continuously.

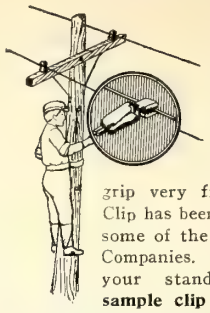
The drawing shows very plainly how the plan is worked. Lay an electric fan on its back in a small box. Then tie a lot of strings on the box extending them up to a barrel hoop fastened to the top of the background. Inside of the strings put four or five toy balloons. Then start the fan. The balloons will bob up and down and the people will stop and look. They can't help it. They cannot see the fan, and this will give the impression that the balloons are being propelled by some mysterious force.

One merchant who tried this plan painted a letter on each balloon. Together they represented some word. He advertised that he would give a prize to the person who guessed the word. It seemed to him that nearly everybody in town tried to patch the word together from the letters on the balloons as they bobbed up and down with rhythmic regularity.

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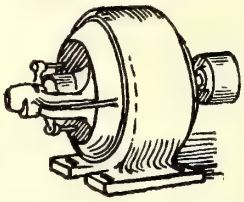
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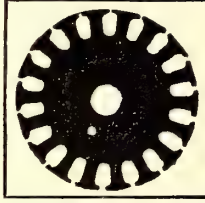
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The Classified Columns of "The Electrical Experimenter" Bring Positive Results.

WILL SWAP—A Savage 22-caliber 7-shot repeating rifle, also a 32 6-shot double-action revolver. What have you? Henry Priebe, Kent, Ohio.

FOR SALE—Amco 1,800 Meter L. C., 1 loader, 1 F. C. and 1 mineral detector. $5.00. Uriel Myers, Charleston, Mo.

FOR SALE OR TRADE—7,000-meter loose coupler, 1 universal, 3 galena detectors, junior fixed condenser, 1 test buzzer, 1 D. P. D. T. and 1 S. P. D. T. switch, 1 fuse block, 3 lbs. antenium wire, 8 insulators; perfect condition. Prefer motorcycle. Will sell separately. Goods cost $45. H. C. Spencer, 110 Davis St., Syracuse, N. Y.

SALE OR EXCHANGE—Brandes 1,000-ohm receiver, volt-meter K. & D. What have you? Alexander Bollerer, 77 Linwood St., New Britain, Conn.

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EXCHANGE—General Electric Hot Wire Meter ($25) for Brandes Transatlantic Phones. Platt, Wentworth St., Bridgeport, Conn.

FOR SALE—Cabinet receiving set in excellent condition. Receives Arlington, Va. Only $10. For further information write Oliver Black, 19 Charles St., Lawrence, Mass.

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CARD Press Outfit. New. Cut-making outfit. Take 3A folding Kodak automatic shutter case with strap. W. G. Kulp, R. No. 2, Elizabethtown, Pa.

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EXCHANGE — Hawkin's Mechanical Drawing; Belding's Commercial Correspondence; Engineer's Examinations; for **Giant Sounder.** Mark S. Kistler, Centreport, Pa.

HAVE Loose Coupler; want 2,000 phones. Joseph Kennedy, 27 Waverly St., Springfield, Mass.

I WANT to swap a brand new Crystaloi Detector for an Interstate wireless outfit. L. J. Becker, 2924-L, Galveston, Texas.

FOR SALE—1,500-meter bare wire loose coupler, $2.50; also $25 violin and case for $5. Fine shape. Will trade for transformer or other transmitting apparatus. Also Crystaloi Detector, $2; 800-meter tuning coil, $1.25; slide plate variable condenser, 75c.; $7.50 Model Builder Set, $4; 2½-inch film-developing tank, $2. Herman Straab, 41 North 4th, Ironton, Ohio.

I HAVE a valuable idea, but lack money to patent and promote. Will sell or exchange. What do you offer? Write to A. M. Niemi, Van Etten, N. Y.

EXCHANGE OR SALE—2-inch coil, headset, adjustable sending condenser, 7 Edison 150-ampere-hour batteries, telephone generator, detector, 2 gaps, 2 flashlights, 2 motors and 2 wireless switches. Will exchange for good motorcycle motor or sell right. All letters answered. Write Seward E. Owen, Vienna, S. D.

FOR SALE—Receiving and sending wireless set, mounted. Aerial wires, insulators; instruments new. Sacrifice for $15. Sterling, 78 Third Ave., Brooklyn, N. Y.

FIRST Money Order for $9.50 takes new Crystaloi detector, cost $6. Loose coupler, cost $3.50, and single headset, cost $3.55. P. Adams, 96 West Housatonic, Pittsfield, Mass.

FOR SALE OR EXCHANGE — $8 Radiopticon post card projector with acetylene generator. In perfect condition. Will sell for $4. Would exchange for loose coupler, phones, or what have you electrical? Louis Folsom, North Dexter, Maine.

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It Pays to Read These Columns

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FOR SALE—One-half-inch Duplex Spark Coil, Key, Loose Coupler, two 75-ohm Receivers with band. Will give two Switches free. All for $10. No trades. Arthur Sager, 941 Superior St., Appleton, Wis.

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FOR SALE OR EXCHANGE—One-half-inch spark coil, spark gap, detector, sending condenser, receiving outfit, variable condenser. What have you to exchange? Alvin Lindstrom, Alpha, Ill.

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HAVE $5 mirroscope and 22 cal. target pistol. Will trade for pair of transatlantic phones, or what have you? Harry R. Fees, Guthrie, Okla.

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FOR SALE—Murdock 1,000-ohm receiver and cord, $1. Also 1-inch spark coil, $2. Both new and in A1 condition. Wm. Ranft, 4107 Belle Ave., Baltimore, Md.

FOR SALE—Telephone, ¼-inch coil condenser, ½-inch coil motor, detector, receiving condenser and gap. Uriel Myers, Charleston, Mo.

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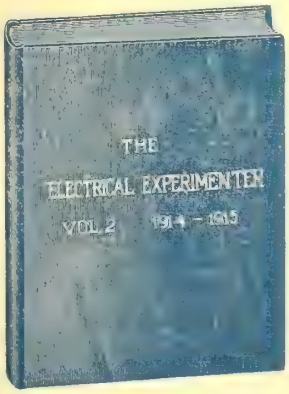
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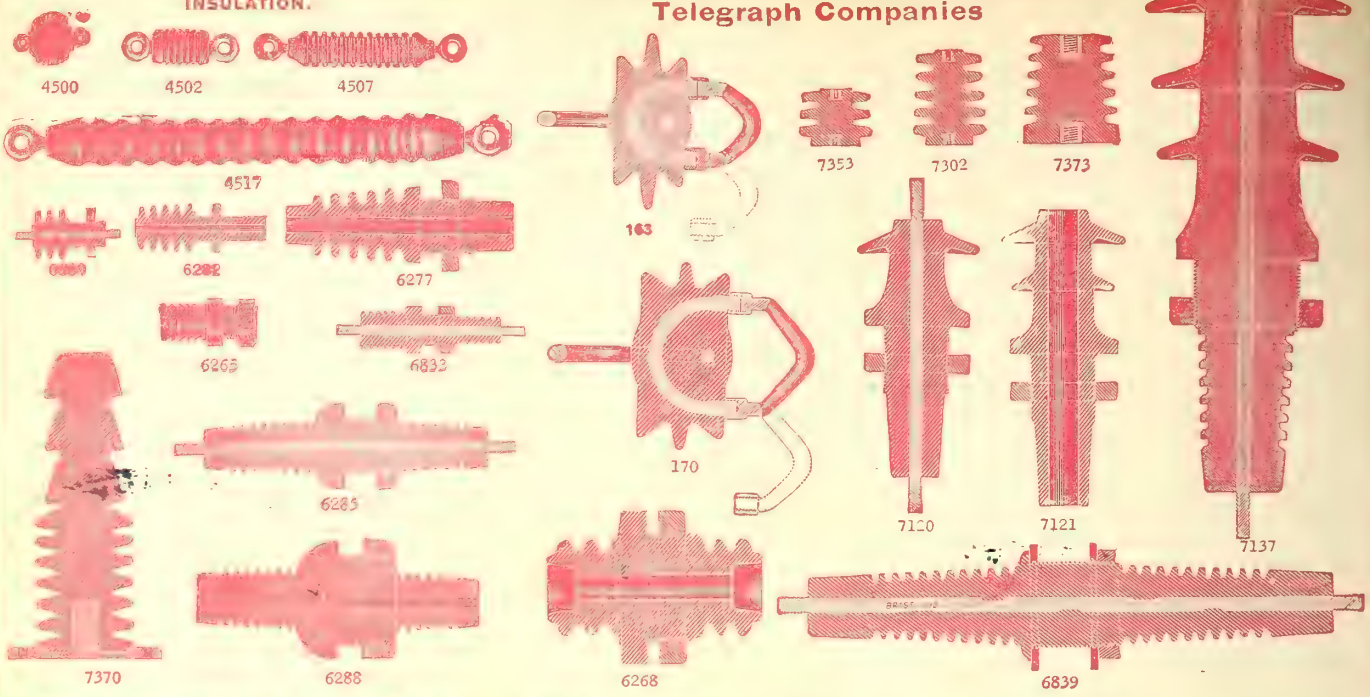
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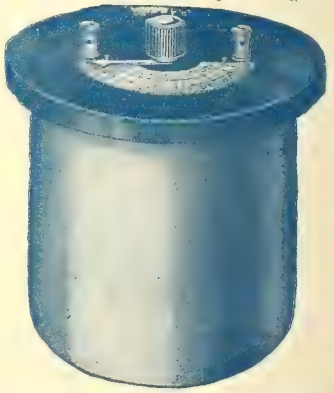
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Vol. III Whole No. 30 CONTENTS FOR OCTOBER, 1915 No. 6

FRONT COVER—"AURORA BOREALIS." From painting by Thom. N. Wrenn.
THE AURORA BOREALIS OR THE NORTHERN LIGHTS..... By H. Winfield Secor 243
BARON MUNCHHAUSEN'S NEW SCIENTIFIC ADVENTURES. By Hugo Gernsback 246
THE GRAVITATION NULLIFIER. (A Scientific Story.)..... By George Frederic Stratton 249
CONSERVING UNCLE GEORGE.....By Thomas Reed 252
CAN ELECTRICITY TRANSFER THOUGHT WAVES?..... 253
ELECTRIC TOYS THAT RESPOND TO THE VOICE..... 255
A LIGHTHOUSE OPERATED AND CHECKED BY ELECTRICITY By E. O. Catford 256
ELECTRIC DENTAL SIGN THAT DEMONSTRATES "BEFORE" AND "AFTER" EFFECTS..... 256
INSTALLING A COMPLETE ELECTRIC SERVICE IN FIFTEEN MINUTES 257
TELEPHONE THAT TELLS WHO CALLED WHILE YOU WERE OUT 258
A TELEPHONIC NURSEMAID AND A BIRD ALARM..... By F. C. Perkins 258
AN ELECTRO-MAGNETIC NAIL-PACKING MACHINE..... By F. C. Perkins 259
ELECTRICITY ON GERMAN SUBMARINES..... 260
MARCONI HEADS WIRELESS CORPS OF ITALIAN ARMY... 261
A NEW ELECTRICAL PHOTO PRINTER..... 261
HOW THE "MOVIES" EXPLOIT WIRELESS..... 262
LARGEST STATIC MACHINE IN THE WORLD..... 263
ELECTRIC SPARK PICTURES—HOW TO MAKE THEM..... 265
NEW TELEPHONE SET FOR AVIATORS..... 266
ELECTRICITY AND THE MODERN AUTOMOBILE TORPEDO. By Samuel Cohen 267
MODERN APPLICATIONS OF THE LOUD SPEAKING TELEPHONE 268
"THE CONSTRUCTOR" DEPARTMENT..... 269
"RADIO" DEPARTMENT 273
RECEIVING WIRELESS MESSAGES WITH ODD AERIALS...274-275
"HOW-TO-MAKE-IT" DEPARTMENT 282
WRINKLES, RECIPES AND FORMULAS. Edited by S. Gernsback 285
"WITH THE AMATEURS" 286-287
LATEST PATENTS 288
PHONEY PATENTS 289
QUESTION BOX 290
PATENT ADVICE 295

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The Wireless Amateur

WE have often had occasion to feel amused at the blank astonishment of the average well-informed European when he first spies the hundreds of aerials which now decorate a multitude of houses in our cities. When we inform the stranger that, according to trustworthy statistics, there are now between 350,000 and 400,000 purely amateur Wireless stations scattered all over the United States, there is no end to his wonder.

This is not surprising if we consider the fact that the United States to-day is the only country that places practically no restrictions upon the Wireless amateur. In America everybody is allowed to put up a Radio receiving station, and while a license must be obtained for sending messages the regulations are far from severe and any intelligent youth, as a rule, finds it comparatively easy to obtain the coveted license.

Now let us turn to other countries. Of course, during the war in the affected countries no amateur stations are allowed to operate, the penalties for the offenders being extremely severe and usually a long term of imprisonment is meted out to the unlucky operator.

The conditions prevailing before the war and which will presumably prevail again after peace is re-established are briefly these:

Great Britain and its dependencies: No Wireless amateur stations can be erected without the consent of the Postmaster General. In Australia, previous to the war, amateur Wireless was all but suppressed. Of England's colonies Canada probably has the greatest Wireless freedom, although a license from the Postmaster must be obtained. In Great Britain proper, it has been estimated that not more than 2,000 amateur Wireless stations prospered before the war. In France and its colonies and in Belgium the same conditions prevailed as in Great Britain. It seems, however, that the French amateurs, just previous to the outbreak of the war, engaged in a petition to the Government, pleading for greater Radio freedom. Results of the petition are unknown at this time. Of all the foreign amateurs the French are probably the most active. Before the war some 1,500 amateur Wireless stations were known to exist in France and Belgium, according to the best authorities.

In Germany, Austria-Hungary and Russia amateur Wireless is absolutely unknown. There have never been any amateur Radio stations in these countries to the best of our knowledge. The governments of the above countries are exceedingly strict in the transmission of intelligence by Radio telegraphy and no licenses are ever granted, with the exception of those to savants and to a few universities. But even here the restrictions are formidable.

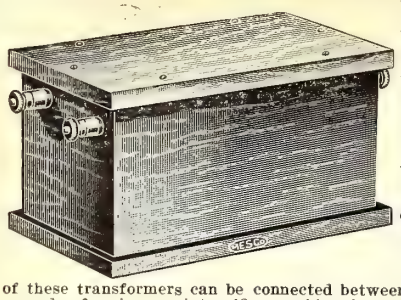
The rest of the world, with the possible exception of a few South American countries where less than 200 stations flourish, measures up poorly as far as the Wireless amateur is concerned. It is believed that outside of the countries named there now exist less than 300 amateur radio stations. Outside the United States there are, therefore, considerably less than 15,000 such stations. In other words, there are in America twenty-five times as many amateur Radio stations as in the entire world. It is, indeed, a surprising result and speaks well for the enterprise of the American experimenters.

Nor can the average European understand of what earthly good the youthful Radio amateur is, for he argues correctly that not all of them can possibly become commercial operators. But he forgets that the average amateur must of needs have a higher intelligence than his card-playing, dance-hall-resorting classmate. Indeed, when your average Radio amateur has mastered all the intricacies of a Wireless set, he has obtained a pretty thorough knowledge of electricity in general. As a rule, most of our electrical industries, big and little, require thoroughly practical young men, the ones who know how to do things. This is where the amateur shines, and nine times out of ten he lands the job over the head of the untrained, theoretical young man.

For this reason American parents, as a rule, encourage their son, for they know that he does not waste his time. The amateur wireless station seems to be a first-class investment.

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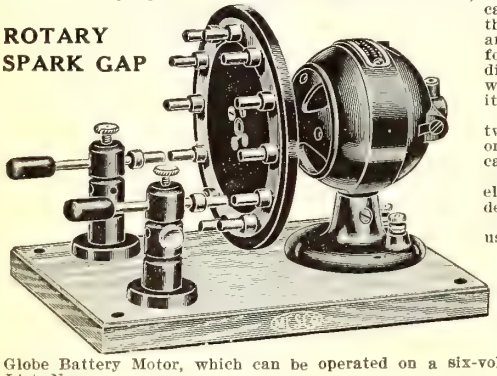
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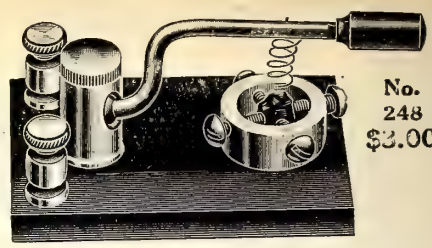
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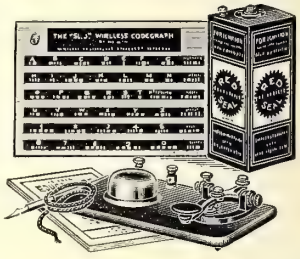
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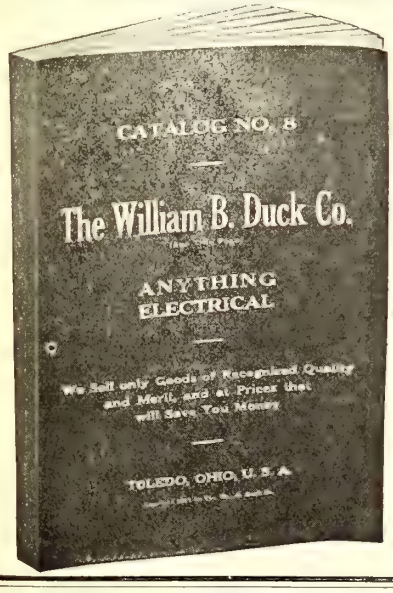
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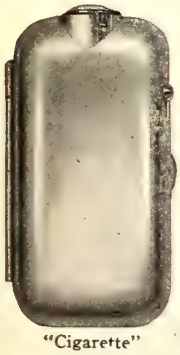
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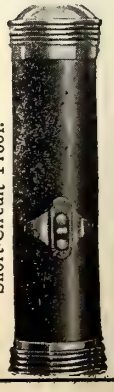
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THE ELECTRICAL EXPERIMENTER

H. GERNSBACK EDITOR
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Vol. III. Whole No. 30 OCTOBER, 1915 Number 6

The Aurora Borealis or the Northern Lights

By H. Winfield Secor

THE Aurora Borealis, or as it is commonly known, the *Northern Lights,* constitutes one of those great scientific problems which bid fair to puzzle the keenest wits in their solution for years to come. Those of us who live in the temperate or tropical zones of the earth have probably never witnessed to any great extent, the truly indescribable and marvelously beautiful color effects, produced by the Aurora Borealis, or also by the Aurora Australis. When these spectacular effects of nature are seen in the neighborhood of the North Pole, or at least in that direction, they are known as the "Aurora Borealis." When seen in the vicinity of the South Pole or in that direction (with respect to the observer's location), they are termed the "Aurora Australis."

The word Aurora Borealis (and referring to the northern polar lights, frequently observable in the heavens), was first used by Gassendi in the year 1621, or so our science books tell us.

Up until the last century there were many wild tales published in various parts of the world with respect to the Aurora Borealis and as to what it looked like, as well as to the other physical properties manifested by this little understood phenomenon occurring in nature. It is generally conceded to-day to be an electrical discharge taking place through the highly rarefied upper atmospheric strata surrounding the earth. Although many writers have claimed that there is a distinct sound accompanying such Auroral discharges or demonstrations, it is pointed out in most reliable scientific works on the subject that there is no sound noticeable when these Auroral effects take place, or at least no sound that can be attributable directly to them. Several explorers and scientists who have studied this phenomenon closely mention distinctly that sounds have been heard simultaneously when these Auroral effects occur, but in many cases, and quite possibly in all cases, therefore, these sounds were found to emanate from such causes as the shifting of large ice fields, the continual changing of large snow deposits or other minor sources.

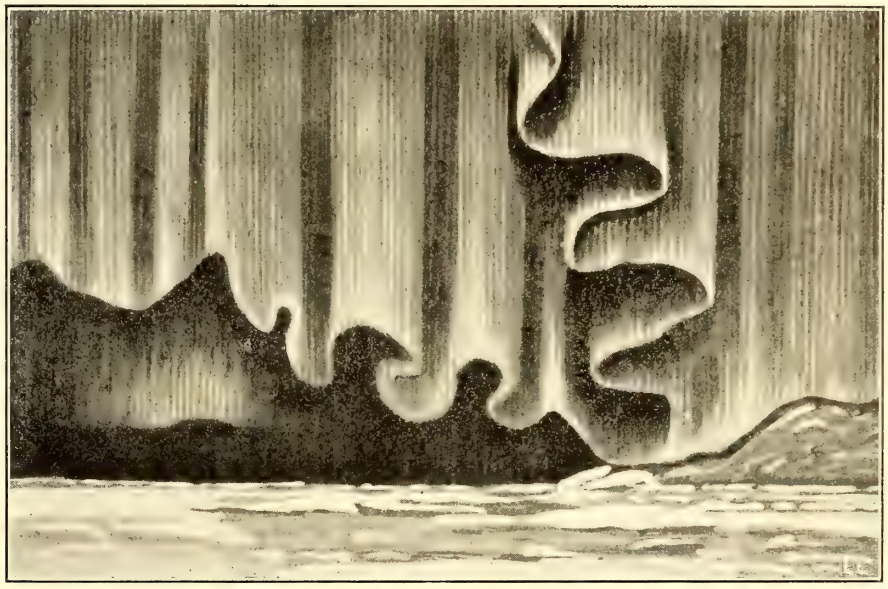


Fig. 1. Beautiful Ribbon Effect of Aurora Borealis When Viewed at Close Range in Northern Countries.

As regards the matter of any distinct odor or smell noticeable from the Aurora Borealis effect some authorities have claimed that there is discernible a distinctly irritating odor similar to that produced from "ozone," or practically speaking the same as we all have noticed after a heavy thunder storm has passed. The "ozone" in this case is due to the lightning discharges striking through the atmosphere and purifying same. Ozone is thought to be a certain form of oxygen.

Contrary to general belief the strength of the light given forth by the largest Auroras is much inferior to that of the full moon. This fact is mentioned by those who have studied the Aurora in the Northern regions at close range. Tests carried out by reading a printed page, etc., prove that generally speaking the maximum light from the Aurora Borealis rarely exceeds that of the moon in its first quarter, which is, of course, quite weak, or in other words, reading an ordinary book page was just possible. The duration of the Aurora display may be but a fraction of an hour or it sometimes exists for several hours, fluctuating all the while.

The color of the Aurora Borealis is one of the least understood at the present day by the layman. In general it is usually composed of more or less vivid red, yellow and green shades. The front cover illustration, reproduced from an oil painting especially painted for the *Electrical Experimenter,* shows some of the enchanting beauties of this wonderful display produced by nature and which has been viewed only in all its magnificent pristine glory by very few men indeed, as such a worthwhile view is obtained only by making a pilgrimage to the regions adjacent to the North Pole.

The above mentioned painting is the only one in existence to our knowledge showing the Aurora Borealis in its true colors. It was originally conceived by Mr. H. Gernsback who is responsible for its accuracy; it required several weeks of careful as well as painstaking work in order to enable the talented artist, Mr. Thom. N. Wrenn, to start the painting. Several experts on the

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Aurora including Mr. Arctowsky, of New York, were consulted during that time.

A good idea as to the general appearance of the Aurora is best had by quoting a few words from Alexander Von Humboldt, the famous explorer, who had the good fortune to witness a number of excellent Auroras at close range.



Fig. 2. The Aurora Borealis Resembles a Mighty Curtain Flapping in the Breeze.

Says this scientist, "Consider that the sky becomes at first slightly overcast and a little later a dark segment seems to form in the firmament overhead. This dark segment passes from the form of a dark shadowy cloud into a beautiful brown or violet shade. A broad, brightly luminous arch is noted, which slightly encircles the dark segment. This arch remains sometimes for hours together, flashing and kindling in a marvelous and ever varying series of undulations before rays and streamers branch out from it, shooting upward toward the zenith. The more intensive the discharge of the Northern Lights, the more bright is the play of colors, furthered by the variety graduation from violet and bluish white to green and crimson. If the observer is fortunate, as some have been, he may perchance see the most wonderful sight possible for any human, or that known as the *Crown of the Northern Lights*. This effect is caused by the rays or streamers darting upward from the curtain-like band, closing in, so as to form a *bowl* or *halo*. It is practically impossible to artificially produce or describe in words the truly magnificent effect thus attained by nature's handiwork and which probably will never be duplicated by man artificially, or at least never on any such grand scale, as occurs in the Northermost regions of the earth, which few, indeed, ever visit."

The illustrations at Figs. 1 and 2 give a fair idea as to how the Aurora Borealis extends upwards into the sky in the form of a ribbon or waving sheet. This ribbon formation is made up of a myriad of flashes or stripes, so to speak, which are continually changing in intensity and color value, being of a bright red at their base, yellow at the center and green at the top usually. When viewed through the "spectroscope," the light of the Northern Aurora appears a vivid green and its wave length has been established to have a value of 5,570 standard units.

Sir William Ramsay, the noted English scientist, made a number of laboratory tests some time ago with various gases, notably Krypton. When electric discharges were passed through this gas, there was noted, when viewing it through a spectroscope, a *vivid green light*, similar to that produced by the Aurora Borealis, and its wave length was ascertained to be 5,570.5 standard units. On the strength of this phenomenon Sir William Ramsay believes that the Aurora seen in nature may undoubtedly be produced by electrical discharges (in the upper rarefied atmosphere of the earth) and passing through a gas in which Krypton is present to a large extent.

As regards the scientific theory covering the possible nature of the phenomenon known as the Aurora Borealis, it may be said that practically all of these now depend upon some electrical discharge action for their basis. In fact, as early as 1714, Halley, the famous astronomer, hazarded a guess that the Aurora Borealis was a magnetic phenomenon, due to the electrical charge existing on the earth and also in the air above it.

There are two principal theories now worth considering which endeavor to explain the whyfore and the where of the Aurora Borealis. One of these is that due to Prof. Birkeland, of Christiania, Norway, and the other comes from Prof. Svante Arrhenius, of Stockholm, Sweden.

To elucidate, it may be said that we have long known that *violet light rays*, and particularly the invisible rays of the ordinary spectrum beyond the violet (which are easily detected by photographic means), possess the property of discharging a negatively electrified body. It is suggested by Prof. Birkeland that the spots on the sun are caused by solar eruptions, and that the sun is then caused to give forth an extraordinary amount of negatively charged corpuscles, not unlike those which constitute the cathode rays. These rays are similar to those utilized for surgical practises in taking X-Ray pictures of the body.

Prof. Birkeland then supposes that such corpuscles are "sucked" into the earth's *magnetic poles*, giving rise to vortices or whirlpools of electric current in the upper strata of the atmosphere. As is well known, such rays can, of course, be deflected by a magnet. Also the presence of large solar or "sun spots" is invariably accompanied by powerful magnetic storms on the earth, as they are termed, and which often cause trouble on telegraph and other circuits over many widely scattered parts of our globe. Also in conjunction with these large solar spots and magnetic storms there are invariably produced very brilliant Aurorae.

Prof. Arrhenius believes that the corpuscles emitted by the sun are not inconceivably minute bodies, but that they do have an appreciable size. For instance, let us say they are 1/1,000 millimeter or 1/25,000 inch in diameter. Furthermore, that these corpuscles are expelled from the sun by the repulsive action of radiant light. Also that such radiant light in thus capable of propagating or thrusting particles out into space in spite of the enormous gravitational pull of the solar planet. This latter fact has been demonstrated a number of times in the laboratory, viz., that it is possible for light to exert a distinct force. Again, Profs. Nichols and Hull have experimentally proved and demonstrated that light does exert pressure to a very marked extent, relatively speaking, and therefore there seems to be nothing inconsistent with Arrhenius's hypothesis.

Whether we like to accept the theories of Birkeland or Arrhenius as correct or not, it does seem quite possible that negatively electrified gaseous molecules are present in the upper strata of the atmosphere surrounding the earth. Also it seems quite likely that these molecules receive their electric charge most easily where they are most exposed to a vertical sun. In other words, this would be at the equator, or nearly so. These upper aerial currents, so to speak (and according to the theory of Prof. James Thomson), will carry these and other molecules towards the earth's magnetic poles, designated as the North and South Poles, respectively. These molecular streams would move spirally northward and southward with an easterly trend. As they approach the vicinity of the magnetic poles of the earth, their number per unit area would quite obviously be greatly increased, owing to the fact that the terrestrial parallels of altitude degrees grow less in circumference, the closer they are to the "poles." It can also be expected, we are led to believe, that before the magnetic "poles" themselves are reached the potential of the upper air should increase to so marked an extent as to produce a distinctly apparent *luminous electric discharge*. This luminous discharge moreover being in the form of a ring or halo about the magnetic poles of the earth. This particular fact has been noticed by most of the explorers and investigators of the Aurora Borealis. It is this ring or

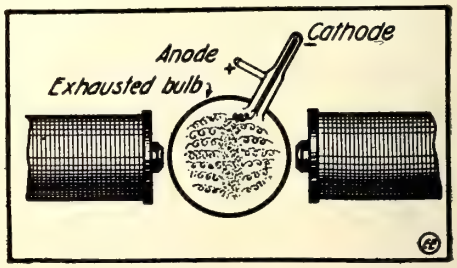


Fig. 3. Producing an Artificial "Aurora Borealis" in the Laboratory.

halo, which we see as an arch in the sky from most ordinary view points, attainable by the average observer.

Figs. 1 and 2 show this *arch effect* that some travelers in Northern regions have had the good fortune to see. These curtains of fire forming the Aurora rise upward and in the course of a short space of time they would close in so as to form a parabola or bowl formation. Also it was noted that the axial center of this bowl formation was the *magnetic pole* of the

earth. A number of mathematical calculations were made in order to check this, as well as the usual observations as taken by regular explorer's instruments.

Prof. Paulsen classes the Aurorae into two divisions. Those considered in the "first class" are those which are widely extended in their formation and also quite steady. They show no streamers worth mentioning. Generally speaking, they tend to rise slowly toward the zenith, and they do not affect the magnetic or compass needle appreciably. An Aurora of this type usually appears in the form of an arch or a multitude of arches. Extended regions of the Arctic and Antarctic skies often glow with a faint light, like translucent clouds. These luminous masses are very often observed 1,000 feet above the ground.

In the "second class" in the category of Aurorae may be mentioned those characterized by streamers or very distinct rays, which may be either sharply separated or they may blend at the bottom, presenting the appearance of mighty curtains, flapping gently, now rapidly, in the breeze.

It has been noted that these rays are invariably parallel with the magnetic or compass needle and when viewed perspectively, they appear to diverge from the center of a radially striped corona. Aurorae of this class are not steady, but are traversed by a series of waves, as they rise from the Northern horizon and also they deflect the compass needle to the east, but after passing the zenith they cause a westward deviation of same. From these observations, Prof. Paulsen is inclined to believe that these streamers are only rays in which negative electric charges move downward toward the earth itself.

As our illustrations indicate, the Aurora Borealis does not start from the very edge of the horizon proper, but it begins at a considerable distance above the earth. The altitude of the base of the arches formed by the *Aurora ribbon*, if we may so call it, has been measured in various ways a number of times by explorers and others making a study of the subject. From various calculations by means of trigonometry and geometry and also by measurements made direct with surveying instruments, the average altitude of the arch above the earth's surface has been found to vary from 20 to 100 miles. Perhaps the highest altitudes that have been deduced, says Alfred Angot, in his excellent work on the subject are the following: as measured by Dalton, 150 miles; Loomis, 400 to 600 miles; Bergman, 468 miles; Boskovitch, 320; Fournerin, 1,006; Twining, 1,100 miles; Boller, 1,243 miles.

The upper altitude of these arches, of course, is naturally considerably higher, depending upon the magnitude of the particular Aurora observed.

Regarding the periodicity of the Aurora Borealis it may be said that for one thing it occurs as intimated previously, with every recurrence of large sun spots. Finally and in spite of its apparent irregularity, the Aurora Borealis seems to follow a well-established routine as to its occurrence and recurrence. The periods fairly well established for its appearance may be summed up as follows:

The diurnal period, the annual period and the period of a little more than 11 years. Among the occurrence periods not exactly known, but of which the existence seems to be proven, there is one of about 28 to 30 days and another of about 55½ years. Other occurrence periods have been surmised and mentioned by different authorities and investigators, especially a period of about 220 years, but they seem rather doubtful.

(*Continued on page* 300.)

Wireless and Telephone Find Extensive Use in European Armies

Wireless telegraphy, as well as wire telegraphy and telephony, has found very extended application in the vast armies now battling over the face of Europe. It is surprising how quickly communication by telegraph, telephone or radio can be established between widely extended points of a mobile army. The telegraph and telephone wires are usually, in this case, let out from a reel carried on horseback, the horse also carrying a signal corps engineer.



Photos by Paul Thompson.

Above: Modern Wireless "Cart" Set in Use by British Army in the Present Terrific European Conflict.

Below: German "Telephone" Station in Use at Advanced Posts in France.

It goes without saying that if it were not for the rapid and far-reaching means of communication now available, thanks to electricity, the rapid movement of troops could never be attempted with the success now attending such manoeuvres under actual battle conditions, as demonstrated time and again by the Germans as well as by the Allies' forces.

Our first photograph shows a modern wireless "cart" set as used in the British army. These sets are very compact and can be unpacked and set up, ready for operation in transmitting radiograms over sections of several hundred miles, in a few minutes' time.

An oil or a gasoline engine is usually employed to drive an alternating-current generator, and the transformers in the radio transmitting set are thus supplied with current. These sets, as here shown, are usually rated at 1½ to 2 kw. and utilize a collapsible steel or wooden mast having a total height of 80 to 90 feet.

The second illustration shows the field "wire" telephone apparatus in actual use by the signal corps of the German army. This particular photograph was taken at one of the outlying advance posts of the German army near the Aisne. These telephone stations are indicated by a large letter "T" hung on the tree, as perceived. This is for the guidance only, of course, of members of the local regiment to which the instruments belong.

As may be seen, the apparatus is quite heavy in its make-up, and it is extremely necessary that such apparatus shall be very rugged, so as to withstand the severe wear and tear of military requirements. It

EXPORTERS ARE TOLD TO USE WIRELESS.

The American State Department, through the Atlanta Chamber of Commerce, recently notified Southern exporters to handle their foreign communications by wireless telegraphy to avoid the strict censorship which the belligerent nations have maintained on all cablegrams from the United States since the outbreak of the war.

This information was sent from Washington by Second Assistant Secretary of State Alvey A. Adee, following a protest from the chamber recently that a number of Atlanta exporting houses had been unable to communicate with their foreign agents on commercial matters by cablegram.

It has been advised by the State Department that the Postal Telegraph lines be used when wireless messages are sent via the Sayville radio station, and that the Western Union wires be used in the transmission of air messages from the Tuckerton radio station.

We want to buy May. '13, Oct., '13, and Jan., '14, copies "E. E." Address the Editor.

Baron Münchhausen's New Scientific Adventures

By Hugo Gernsback

Münchhausen Departs for the Planet Mars

ONCE upon a time a grouchy old gentleman with a grievance for fiction writers, presumably because the latter received more emoluments for their stuff than the former for his poetry, thus vented his resentment in immortal song:

"'Tis strange, but true; for truth is always strange—stranger than fiction."

From this some coarse soul, totally oblivious of any poetic infection whatsoever, took it upon himself to mutilate the above passage of one of Lord Byron's poems and taught us unsuspecting mortals to hawk, parrot-wise, ever after until the end of fiction, thusly: "Truth is stranger than fiction!"

With all due regard to the memory and genius of Byron, I, I. M. Alier, a citizen of a free country, take it upon myself to correct his Lordship at this late and quarrelsome date, to wit:

"There is no fiction."

If, as often—no, always—has been proved that the most violent fiction at some time or other invariably comes true, then by all proceeds of modern logic, there cannot be such a thing as fiction. It simply does not exist. This brings us face to face with the startling result that if fiction always comes true some time or other, why then, bless their dear souls, all fiction writers must be prophets!! Hurrah for the F. W.!! But hold on, boys; don't let our enthusiasm run away with us on a Ford. The spark plug has run afoul somewhere. While it's nice to be a prophet, don't you forget that a prophet is never, never recognized in his own country. Thus the New Testament teaches; so I think it will be safer for all F. W. to remain F. W., rather than to be honorless prophets.

However, that is not what I had in mind when I started—it's so hard for me to say what I mean, and a good deal harder for me to keep my thoughts running on the track. They ramble from one nothingness into another. My mind in that respect is a good deal like a one-eyed, religious old cow on a pasture. She eats up whatever she sees alongside of her, but when she finally turns around she perceives with astonishment that there is still a whole lot to graze on the other side; so she steers around to starboard and returns to her original starting point.

But I am rambling again. So let's return to the original starting point.

Seriously speaking, and by way of emphasizing how much stranger truth is than fiction, I have but to point to Jules Verne's famous stories. When 45 years ago he wrote *"Twenty Thousand Leagues Under the Sea"* no one took him serious. It is doubtful whether he himself believed that the submarine which he invented in that story would ever become practical. It was just fiction. Yet 45 years later we see how a submarine, almost exactly as his vivid as well as prophetic mind conceived it, down to the most minute detail, emerges from a German harbor and travels under its own power over a distance of 4,000 miles, through the North Sea, the English Channel, down the Atlantic, through the entire length of the Mediterranean and up through the Dardanelles to Constantinople! And by way of diversion it manages to sink several battleships of the enemy by means of its torpedoes. Now, bold as he was, Jules Verne never conceived such an "impossible thing," and while his famous *Nautilus* was equipped with almost every other modern submarine necessity, the infernal automobile-torpedo was missing. Truth is indeed very much stranger than fiction. Hundreds of similar instances could be cited, but lack of space prohibits it; besides, I mustn't ramble!*

Münchhausen, as will be remembered, had explained the mysteries of the moon to me, and he had also mentioned the great danger of falling meteors, which had been increasing alarmingly in number for some time. †The moon's attenuated atmosphere offered no protection from meteors, as did the earth's thick air. But few meteors ever reach the surface of the earth; the colossal friction between the meteor and the air ignites the former and most of it falls down on the earth as a fine dust. The burning of the meteors represents the shooting stars we see. On the moon, however, the meteors crash down bodily, causing tremendous havoc, and this terrible bombardment goes on forever without letup.† Consequently, when Baron Münchhausen stopped short that evening in the midst of a sentence, I naturally was alarmed not a little. Great, therefore, was my joy when, sitting before my radio set the next evening, 'phones clapped tight over my ears, my eyes glued on the clock, the familiar high, whining spark suddenly reverberated in my ears at the stroke of 11 o'clock.

It was Münchhausen. But his usual sonorous voice to-night had an unfamiliar metallic timbre that puzzled me greatly; in a short time, however, the mystery was cleared, and this is what poured in my astonished ears:

"My dear Alier. No doubt you thought I had been killed by a meteor last night. Well, as you Americans put it, I had indeed 'a close shave.' A meteor crashed down on my aerial 50 feet from where I was sitting; it of course went up in smoke—metal vapor, to be correct—due to the tremendous heat generated by the impact of the meteor on the granite rocks. The whole meteor itself went up in a fiery cloud of red vapor and I was blown headlong a distance of over 50 feet, right down into the mouth of a giant crater, by the colossal resulting blast of the concussion.

"Now, this long-extinct crater is a very deep one; how deep I was soon to learn! I went down head first and kept on falling at a terrible rate of speed. I must have been falling down that awful abyss what seemed to me like hours. As I kept on plunging down I was gloomily reflecting what an inglorious death it was to die down at the bottom of an unromantic crater on a dead and dried-up moon. I thought of many things, when I suddenly became conscious of a terrific cold. Call it instinct or presence of mind, as soon as I had started on my downward journey I had jerked my body in such a manner as to righten it; in other words, after a few attempts I succeeded in falling feet down. It was indeed a fortunate circumstance that the sun was almost directly overhead the crater, for it saved me the anguish of plunging down into a pitch-black abyss. While it was of course not as light as at the top, still I could see where I was falling, and that was at least some consolation. Thus, when I glanced down in the direction of my feet after a while, I am sure that my heart, which had stopped beating, stood still entirely for some seconds. It took me a few seconds to collect my bewildered senses, for this is what I had seen:

"The crater had no bottom at all, but went right through to the center of the moon, where it connected with another crater, *which went to the opposite side of the moon.* I knew this must be so because when I had looked down I had seen several stars shining through brilliantly from the night side of the moon. Then the awful truth flashed through me and I almost swooned. *I was falling through the whole length of the moon!* I had been in many tight quarters before during my somewhat exciting career, but this experience indeed bade well to be the inglorious end of my adventurous life. However, my far-famed presence of mind and my cool head soon asserted themselves, as was naturally to be expected of me.

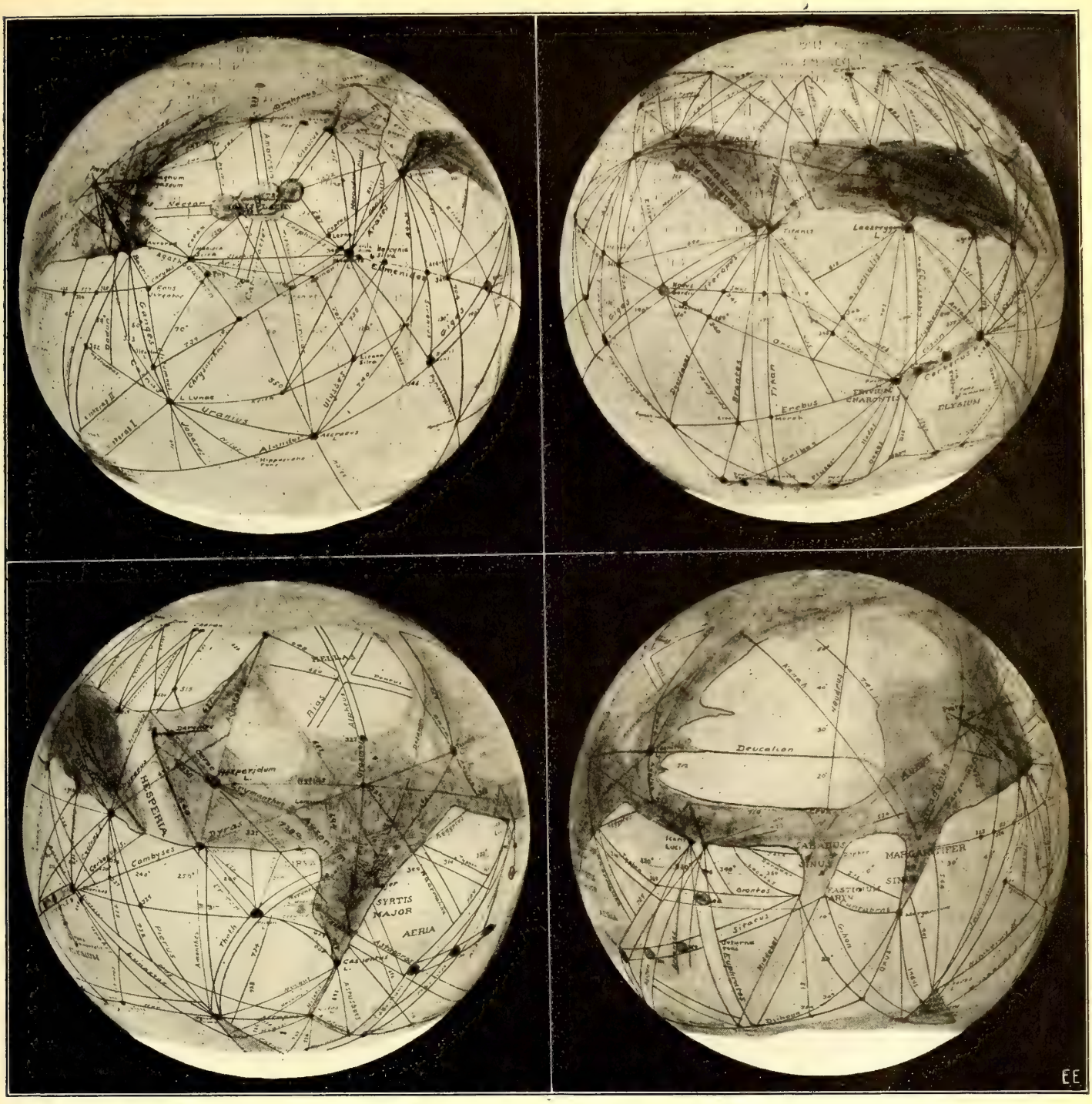
"I knew the diameter of the moon to be

"THERE *are more things in heaven and earth, Horatio, than are dreamt of in your philosophy."* **So sings Shakespeare. One of these "things in heaven" is the Planet Mars, the most fascinating, the most astounding revelation to the feeble human intelligence. Shakespeare, the master of the drama, never conceived anything like a drama of an entire world—millions of intelligent beings—fighting a heroic battle, a battle for existence. Yet this drama was going on right before his very eyes, but 35 million miles away; for the Martians have been fighting for water ages ago, and the available supply becomes smaller each year.**

There is nothing more inspiring, nothing more gripping to the imagination, than this wonderful battle between organized intelligence on one side and unrelenting nature on the other.

Mr. Münchhausen's scientific lecture gives you the latest facts—now almost universally believed—about Mars. You can spend no better half hour than turning your mind from your humdrum existence towards a subject which is as absorbing as it is lofty in its grandeur.

*In order to distinguish facts from fiction in this instalment, all statements containing actual scientific facts will be enclosed between two † marks.—AUTHOR.



Four different views of the planet Mars. As Mars turns on its axis once every 24 hours the same as the earth, we are enabled to see the entire surface of the Martian globe during that time. The four views, as shown, are therefore taken six hours apart from each other. These pictures were made during the last "opposition" in 1911, when Mars was some 47 million miles distant from the earth. It never comes nearer than 35 million miles to the earth. In 1924 the two planets will be but 36 million miles apart. In the views shown *the top is south, the bottom north,* for through the telescope all objects are turned upside down. The white patch at the bottom is the north Polar snow cap, the southern cap is not in evidence for it has melted already. The melted water has been conducted equatorward by the "canals." Note that the canals run through the dark areas, which are not oceans therefore, but land with vegetation. The light areas are deserts. Nearly all canals are perfectly straight, the ones near the edges of the pictures, appear curved only because we are looking on a globe and not on a plane surface.
Photos courtesy of Prof. Percival Lowell, Flagstaff Observatory, Flagstaff, Ariz.

2,164 miles. A quick mental calculation proved that it would take my falling body about 24 minutes to reach the center of the moon. As there was nothing to stop my fall, I must naturally continue to fall, due to the tremendous momentum acquired, till my body would *almost* emerge at the opposite side of the moon at the mouth of the other crater. At this point my speed would be zero and I would have fallen for 48 minutes. If I could not manage then to grasp a projecting rock I would commence to fall back again toward the center of the moon. I reasoned that once more my momentum would carry me past the center and I would then be *almost* carried to the mouth of the opposite crater—my original starting point.

"I say almost, for the friction of my body against the air would tend to retard my fall. If at this point, where my speed was again zero, I could not succeed in taking hold of a projecting rock of the crater's side I would begin to fall down once more, the same as before. I would then continue falling back and forward exactly like a bouncing ball, each time, however—just like a rubber ball—a little less than on the previous plunge. Thus my drops would become of shorter and shorter duration, and finally I would fall no more.

"As I had mentioned before, the sun was almost overhead, shining down into the crater. I also remembered that it was almost exactly 12 o'clock midnight, terrestrial time, when the meteor smashed my aerial; this, then, was the time I started on my remarkable journey into the bowels of the moon. With a tremendous effort I pulled out my chronometer and noted that it was 12.23 a. m. In another minute I would fly past the center of the moon. Looking about, I saw in the uncertain light that I went whizzing through an immense hollow, proving to me that the center of the moon was far from solid, due no doubt to the centrifugal force of the moon at the time when it had not solidified, some millions of years ago. I estimated later that the moon was an immense hollow sphere with a solid crust about 500 miles thick. By way of a homely comparison, the moon therefore must be a hollow globe

like a rubber ball. Like the latter, it is filled inside with air, while its crust can be compared to the rubber of the ball.

"In another minute I had passed the center and was now dropping toward the other side of the moon. If I continued falling in my present position I must naturally emerge at the opposite side with my feet toward the sky, as a little reflection will reveal to you. So once more I jerked my body about, and I was now falling *'up,'* with my head at the top, my feet pointing to the sun. At the end of another 24 minutes I could feel my body slowing up from the terrific speed. As the crater at this side of the moon was fortunately rather narrow, I found little difficulty in reaching for a projecting rock as soon as my plunge had come to a dead stop. I held on for dear life and clambered up a narrow ledge, where I fell down exhausted and panting from my dreadful experience.

"My sensations in falling through 2,164 miles of space, going over 16 miles per second at the center of the moon, you would, of course, like to know. Well, the first minute it is rather unpleasant. Highly so. The place where your stomach should be by right is one vast area of nausea. But once you become accustomed to it it becomes bearable, for there is nothing else to do. You might think that the rush of air would kill you in a few seconds, or else draw all the air out of your lungs, thus asphyxiating you. Neither is the case, for the air is so thin on the moon that the rush is not so terrific as it would be on earth. Also, by keeping the mouth tightly shut and breathing—with difficulty, it is true, through the nose—one does not die in 48 minutes. The friction of the air against my body did not ignite the latter either, with a consequent burning of my dear self. For, as I told you some time ago, the temperature inside of the moon is near the absolute zero, the awful cold of the stellar world. But neither did I freeze to death, for the simple reason that the friction of my body through the attenuated air was just sufficient to heat me up enough so as to keep me comfortable. Thus you see that if it had not been so cold I would have burned up; and vice versa, if the friction of the air against my body had not heated it, I would have frozen to death long before reaching the center of the moon. Then, too, another important point to consider is that on the moon, as explained previously, my body weighed but 27 pounds, against 170 pounds on earth.* This is, of course, a rather small weight, and for that reason my fall was not so terrible as if my body had weighed 170 pounds, as on earth. For that reason, too, I was not attracted so much to the sides of the crater as I would have been if my weight had been greater. Also it was fortunate that the two craters widened out considerably the further down they went into the moon's interior. As a matter of fact, the 'hole' of each crater at no point was less than three miles in diameter. This was indeed very lucky for me, for the following reason:

†"If we drop a stone in a very deep and narrow shaft, as has been shown experimentally on earth, this stone will never reach the bottom. Instead, *it will bury itself into the eastern wall* of the shaft long before reaching bottom, providing the shaft is deep enough. The explanation is that the earth rotates on its axis from west to east at a speed of 1,524 feet per second at the equator. Thus it is apparent that the earth revolves quicker than the stone can fall in a few seconds.* It therefore intercepts the stone's flight, with the result that the stone must of necessity strike the eastern wall of the shaft. This phenomenon is termed 'the falling of a body toward east.'†

"Now, precisely the same condition exists on the moon, of course. Fortunately, I started falling at the western side of the crater, but as the latter was so wide I never came near enough to its eastern wall to hit it. Likewise the other crater, at the opposite side of the moon, measured some four miles in diameter and, while I finally did reach the eastern wall, my flight had come to an end as explained already. Indeed, nature favored me all through, for the moon rotates with a velocity of but 15⅓ feet per second at its equator, against a like speed of 1,524 feet of the earth. For this reason there was no danger that my body would collide with the sides of the crater somewhere in the interior of the moon, for my flight was far more rapid than the speed of the moon's rotation on its axis.

"But in the meanwhile my troubles were far from being terminated. No sooner had I regained my breath than I became conscious of the terrible cold; for I was now but a few feet from the surface of the moon, but on that side which was turned away from the sun, where nothing but icy cold, darkness and desolation reign. Aside from this, I was some 2,160 miles away from Flitternix, my companion, and our 'Interstellar.' Walking around half of the moon was out of the question; neither could I stay where I was without freezing to death. So I climbed up to the surface of the moon with considerable effort. Then by aid of the starlight I ran rapidly around to the western side of the crater, for I had to run in order to keep warm. After having obtained my bearings by aid of the stellar constellations, to make sure that I was at the western side of the crater, I took a deep breath, looked down in the abyss through which the sun was shining from the other side, and dived head down into space once more.

"You see, I had reasoned that it was far better to attempt the flying journey through the moon once more than to perish with the cold on the dark side of the moon. Besides, I had experience now and, having been successful once, it was natural for me to expect success again. I had nothing whatever to lose, but everything to gain.

"My first experience was repeated without any incident; furthermore, I calculated that I should land at the eastern wall of the far crater within 48 minutes if everything ran smoothly. But I had left our good old sun out of my calculations. You see, the gravitational attraction of the sun controlled the fall of my body in the same proportion as it controls the rotation of the moon and the earth, as well as the other planets. I mentioned how in my former flight I had risen to the top of the moon; as a matter of fact, somewhat higher, for the opening of this crater was higher than the surface of the moon. But now I was falling *toward* the sun, and the sun was aiding as well as accelerating my flight; for I moved constantly nearer to it.

"For this reason at the end of 48 minutes I did not strike the eastern end of the crater. Instead I whizzed right past the eastern wall, almost brushing it, and continued to rise up into the air about 100 feet before my speed was spent. I promptly prepared myself to plunge down into the crater again. Indeed, before I realized it I had begun to fall down once more when the unexpected happened.

"I suddenly felt a rope encircling my body, and before I had time to think I was jerked sideways, and in another second I had fallen on a heap of sand and looked with astonishment into Professor Flitternix's eyes, who stood over me grinning sheepishly!

"This is what happened: Flitternix had, of course, seen me fall into the crater, and as he had rushed to the edge he had seen how I dropped down at lightning speed. Looking closer, he also noticed what I saw, namely, that the crater went right through the entire diameter of the moon, for he could see the stars shining through from the other end. He was loath to believe that the fall would kill me, and, as a scientist of note, he calculated exactly in advance what was likely to happen to me. He reflected that it would take me some two hours to make the round trip, as he knew that I could not possibly stay at the other side of the moon. He reasoned, correctly, that in case I was not killed I would come swinging through the crater in due time. Unperturbed as he is by such mere details, he went to the 'Interstellar' and had his lunch. Within two hours he returned to the crater, armed with a telescope and a long rope. It did not take him long to locate me down in the abyss by means of his glass, for I was rapidly coming to the surface then. Attaching one end of the rope to a near-by rock, he fashioned a sliding noose on the other side and waited.

"Now it must be said to the credit of Flitternix that in his younger days he had lived in the West on a ranch, and there had become an expert in the science of lassoing. He boasted that once he lassoed a common sparrow by its left hind leg, but this I believe to be somewhat exaggerated. Be that as it may, when I finally emerged to the surface, a living piece of lava ejected out of an extinct crater, Flitternix had but little trouble in lassoing me as I came whizzing up. Whereupon I thanked him and asked him if lunch was ready, for the trip had given me quite an appetite, as you may well imagine. Luncheon over, we decided right then and there to quit the moon, for Flitternix as well as myself were of the opinion that there was little further to be

(*Continued on page* 297.)

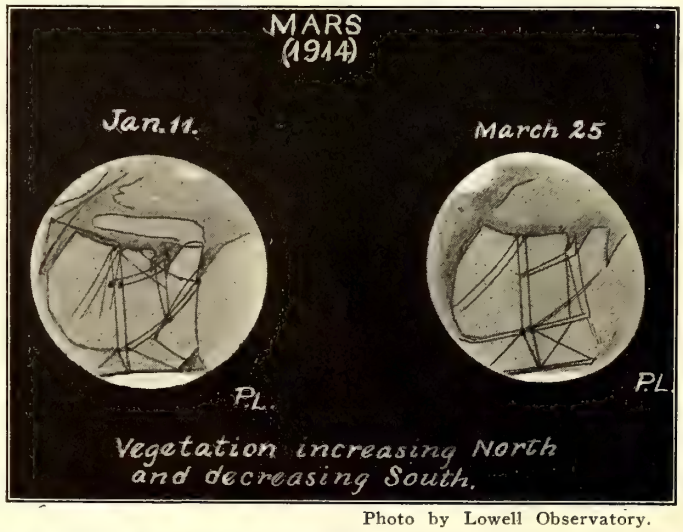


Photo by Lowell Observatory.

*†An object weighing 1 lb. on Earth weighs 0.167 lb. on the Moon.†

*†The speed of a falling body at the surface of the earth after the first second is 16 1-12 feet. In 6 seconds a stone would have traveled but 579.†

The Gravitation Nullifier

Ned Cawthorne, Millionaire, "Floats" a New Issue, but Not of Bonds

By George Frederic Stratton

THE gigantic mogul, No. 73, had been held on a siding on the Santa Fe Railroad waiting for three troop trains to pass on their rush to the Rio Grande. Behind her were 40 empties which she was hauling back to be reloaded with munitions and supplies and again to be rushed to the front.

Blakely, the engineer, who had been 19 hours on the run and saw no relief until he reached Los Lunas, was doggedly morose, for his orders were coming from dapper second lieutenants or curt, brusque majors, instead of through smiling station agents with their crisp telegrams. At last he got his signal and viciously pulled his throttle. There was a furious rush and whir of the 12-coupled drivers but no headway.

He instinctively shut off steam, turned on the sand and again slowly and cautiously opened the throttle with the same result—a whirl of the drivers as if they were the wheels of a child's wagon, spinning in the air.

"Grease?" grunted the fireman.

"There'll be a grease-spot if I catch any blamed fools playin' tricks 'round here!" howled Blakely as he sprang from the cab.

But he found nothing wrong. The rails were dry and in perfect condition; and with a lowering puzzled look he climbed back into the cab, threw over the reversing lever and opened the throttle. There was not the slightest impulse backward or forward.

The sharp exhaust cut out the explosion of picturesque idiom and expletive from Blakely. Then he yelled to the conductor who had come forward: "Cut her loose, Hank!"

The mogul was uncoupled and again the engineer gave her steam and his puzzle became a miracle. The great locomotive started forward with a plunge which threw the fireman back on the coal; the forward trucks sprang clear of the rails and a sharp gust of wind sweeping down the arroya lifted the huge machine into the air and floated it across the main track. Then it settled down in the sagebrush so gently as not to displace one chunk of coal.

Blakely slumped back on his seat, aghast, and the tan on his corrugated cheeks and forehead faded off to a sickly ashen gray. The fireman sprang from the cab, his hair standing on end, but instead of his feet reaching the ground the breeze caught him and wafted him along as though he was thistle down. Fifty yards away he drifted against the telegraph wires and clung to them convulsively. Grouped between him and the engine were the train crew and station helpers, staring in bewildered terror, and a few yards behind them stood a man, dressed in gray, waving what looked like a pocket searchlight, in signals to a biplane, far overhead.

A cavalry lieutenant with a squad of troops galloped round the station and down the track, halting as they reached the man in gray.

"What does this mean, sir? What aeroplane is that, and why are you signaling? Who are you?"

"My name is Cawthorne," smiled the other. "I'm interested in a new device for suspending gravitation, and that biplane is operating it." He turned to the fireman in the wires and shouted: "Drop off at the first lull of the wind. You'll settle down, all right."

The lieutenant spurred close to him. "I suppose you know that the road is under martial law and that you're interfering with its operation. You're under arrest, sir!"



". . . . Thousands of Men Were Wriggling in the Air, Mixed Up with Machine Guns, Mortars and Small Arms."

"Certainly," grinned Cawthorne. "Now, perhaps you'll allow me to put that locomotive again into commission."

He stepped over to the great engine, followed by the officer and his squad, and placing one hand under the cowcatcher lifted the entire front of the locomotive clear of the sagebrush.

"Gravity entirely gone!" he laughed. "Call on two or three of those men to help and we'll put this back on the track in a moment. Then we'll restore its weight and it can go ahead."

The officer scowled and hesitated. Then he ordered four troopers to dismount and help. Two minutes later they had carried it over to the head of the train. As they did so, Cawthorne again signaled the biplane. Then he stepped to the cowcatcher and heaved on it.

"Weight's all back, lieutenant! Now I'm at your service."

Two hours afterwards Cawthorne, escorted by the cavalry squad, arrived at the headquarters of the Fifth Brigade and was immediately taken before General Illington. That grizzly old warrior scrutinized him keenly; then growled:

"You are Mr. Cawthorne—Edward Cawthorne, I am informed."

Ned bowed. The general smiled grimly and continued:

"The man who devised those submarines that have been putting the Jap dreadnaughts to sleep?"

"I am the man who financed them, general. The deviser is a man named Wheaton, of Providence."

"Very effective, sir; whoever did it. But ——," and a scowl darkened his rugged face, "that is no excuse for experimenting on our battle line. Nothing can be an excuse for that, sir!"

"It was not experiment, general; but demonstration. Shall I explain?"

"I will listen to you, sir, but I warn you that no explanation can relieve you of the consequences of your action. You delayed that freight train for nearly ten minutes—a very serious matter at this time! Orderly! Request Captain Berger to come here."

In a few moments the artillery captain appeared. The general muttered:

"Mr. Cawthorne proposes to explain the method by which he floated that locomotive off the tracks. Be seated, gentlemen!"

"Four years ago," Cawthorne related, "a Mr. Farrow showed clearly that the law of gravitation is influenced by the Hertzian waves, and that they, in turn, could be influenced by electricity. I need not take up time to go into the technicalities of it all, but experimentation, right to the limit, has resulted in an apparatus—a condensing generator—which if so handled as to throw an electric zone around anything that has weight, will eliminate that weight, or more properly, will nullify the gravitation. That locomotive was treated from our gyroplane nearly 5,000 feet above it!"

The captain gasped: "Do you mean, Mr. Cawthorne, that it was done without any communication with the earth—that there was no receiving antennae?"

Cawthorne grinned, slipped his hand in his pocket and drew out a few metal balls, as small as buckshot. He handed a couple to the general and the others to the captain.

"Those are the antennae. Simply solid metal balls! I don't care to tell the composition, just now; but they're perfectly harmless. A bushel of them was carried in the gyroplane and a few handfuls thrown down around the locomotive. Then, when the condensing generator was put into action the current found those antennae and the gravitation-suppression instantly occurred."

"Good heavens!" ejaculated the general. "It's beyond the realms of possibility, Mr Cawthorne!"

"Edison says that the limits of the possibilities of science are not yet in sight. What we have done seems impossible because it has never been demonstrated. But, your officer has seen, and has reported to you about the possibility."

"And the influence—or whatever it is—extends only to the radius covered by those balls?" broke in the captain.

"Much further than that, captain. On exhaustive experiments at my country home, conducted very secretly, we found that the influence—that's a good term—extends for fully half a mile on each side of any cluster of balls; although the intensity of the action is at its fullest among those balls. The suppression of gravitation becomes less as the distance increases."

"And yet the altitude of your gyroplane makes no difference?" demanded the general.

"We have worked up to 6,000 feet without finding any difference in the conditions or results."

The captain settled back in his chair and gazed at Cawthorne in blank astonishment, his arms hanging limply on each side of him. The general twisted one end of his gray mustache into his mouth and chewed it meditatively. Presently he growled:

"Why have you not put the war authorities in touch with this, instead of daring to come right onto the field and make a demonstration without even consulting me?"

Cawthorne leaned forward, his brows furrowed deeply and his lips pressed tightly together:

"Two years ago, general, the war authorities were shown this apparatus and they shrugged their shoulders and turned it down. If we had gone to them now with the perfected machine they'd have red-taped it until those Japo-Chinee devils had reached Washington, and then they'd have appointed an investigation committee, with an unlimited period of time for the investigation and tests. War authorities are not field officers, general!"

"That will do, sir! I can listen to no criticisms on the Government." But a twinkle in the stern old eyes softened the harshness of his tones.

"Your gyroplane is here, I suppose you know?"

Cawthorne grinned: "Yes! As soon as I heard where I was to be brought I signaled Kilroth, my assistant, to sail in here and descend. I suppose he's under arrest, too?"

The general smiled grimly but ignored the question.

"How did you expect to follow this up, Mr. Cawthorne?"

"First, by doing just what has happened—getting an interview with you. Next, by sailing over the river and—with your permission—floating all of that Chinee-Japo-Mexican aggregation into the air. How's that?"

The general glanced at the captain, his lips twitching. The next moment both burst into a roar of laughter. As it subsided, the general's hand shot out and grasped Ned's. "We can use you, sir! We'll have to, to save ourselves. I could spare 25 or 30 pounds very willingly, but the rest of my weight I want.

"But, under the regulations of war you'll have to come under my command. I'll appoint you a captain of aviation. Will that do?"

Cawthorne exclaimed bitterly: "It has been my greatest ambition to hold a commission in this war, general; but I have a cork leg—lost the other at polo. Does that disqualify me?"

"Perhaps," smiled the general. "But the aviation service is hardly down to fine restrictions, yet. We'll overlook the cork. What men do you carry in that aeroplane?"

"Two. Kilroth, one of the brainiest mechanics I ever knew, and Littleby, the —er—chauffeur, but there's room for two others."

The general nodded exultantly. "Captain Berger, you are detailed to accompany Mr.—er—Captain Cawthorne. Your rank, as an artillery officer, is above his, but you will act together. Now, I am going to call a council of war which you will both attend. We will then decide on your future movements."

"And in the meantime," laughed Cawthorne, "where am I to report? I am under arrest, you know."

Another laugh broke from the general. "You are on parole now, captain. Orderly! Report at the guard house that Mr. Kilroth and the pilot of that gyroplane are to be immediately released!"

As the orderly left, Cawthorne saluted and said:

"There are on the track at Denver three sealed freight cars consigned to me. They contain three more gyroplanes and a number of gravitation nullifiers. I didn't dare bring them any further for fear of —er—arrest; but they are now under your orders, general!"

"Good heavens! Three more of those machines all ready! Have them forwarded at once, captain! No! I'd better make the order—special run, too! We need all the reinforcements we can summon just now!"

* * *

Four thousand feet in the air the two captains, Cawthorne and Berger, were cruising over the trenches of the mixed brown and yellow men. Around them were a score of United States aeroplanes guarding the G. N. 1 against attacks by Japo-Chinee airships.

The world just below was sparkling with angry flashes of flame preceding the rattle of machine guns and the explosion of shrapnel. The enemy had brought up no heavy guns, but from the American lines across the river came the terrific crash of field siege cannon. As far as Cawthorne could see on both sides of the Rio Grande were gusts of smoke; sometimes spasmodic; sometimes continuous clouds, for the entire line was in action.

Berger was watching the *seleniumphyscho* plate on which, projected by the *J-ray* tube at headquarters, eight miles away, came their orders. Kilroth and Cawthorne were sifting handfuls of the globular antennae—Kilroth called them "attractors"—down onto the line of trenches beneath. Suddenly Berger exclaimed to the pilot:

"Turn back, Everoth! Follow the same line! Now, Captain Cawthorne, put the generator-condenser into action!"

Cawthorne threw the switch and all gazed down. One aeroplane immediately below them was evidently deprived at once of its weight for its pilot lost control and it darted in a complete vertical revolution and then rushed far into the south.

"Must have caught a few of our attractors," grunted Kilroth. "Look below!"

Beneath them was as much confusion as if a tremendous explosion had occurred. Thousands of men were wriggling in the air, mixed up with machine guns, mortars and small arms. Everoth had slowed his motors down to 20 miles an

hour and in 15 minutes the generator condenser had passed over the five-mile line of trenches and utterly demoralized the enemy.

Firing ceased instantly and as the smoke swept away the fighters in the G.N.1 had a clear view as they turned and again sailed over the line. For a half mile ahead and behind them and to each side the enemy and its equipment were in the air, and as a stiff breeze was blowing into the north, thousands of those brown and yellow men and thousands of small arms and big guns were drifting like feathers towards the river.

As the gyroplane passed along and its zone of influence left those aerial enemies, their weight came back as suddenly as it had been nullified, and they dropped onto the plain or into the river. Firing from the American side had ceased and Berger yelled:

"Look Cawthorne! Our men are rushing down the pontoons. They'll have a bridge across in an hour! All we've got to do is to keep these fellows floating and dropping until our troops get across!"

They glided down within 200 feet of the surface. The enemy's aeroplanes had darted away, for as they came within the influence of the nullifier their control became alarmingly erratic. The American airships, previously warned, were prepared and followed the enemy in fierce attack.

Suddenly there was a shrill yell from the pilot, a dark shadow and a crash. One of the enemy's biplanes, recklessly driven or out of control, had rushed into the path of the G.N.1. There was no weight to either of the fliers, but the initial strength of structure was there, and the speed, and in a moment—the nullifier being crumpled out of action—both planes were toppling to the ground. All but Everoth, who came down on rocks and broke both legs, landed in one of the trenches on top of a party of quivering Japs who had crawled back there after the first attack of the mysterious influence. But for the fact that in their aerial flutterings their rifles and even their revolvers had wafted away from them, Cawthorne and his party would have met instant death. But they scrambled out and drawing their own revolvers, clustered about the wrecked gyroplane.

Captain Berger glanced around him. On every side sprawled men, clutching rocks, sagebrush, each other or parts of field guns; anything which, in their abject terror, might keep the weird, mysterious unknown from fluttering them again off their feet. Many of them were dead from plunges from great heights when their weight was restored. Many others were crippled in limbs or ribs. Others were crushed under machine guns or howitzers which had dropped on them.

Down at the extreme right of the line—a position which had been held by Cabellero's Mexicans—Berger saw a large body of them rushing in frantic disorder back across the great plain to timber far in the rear. At another point nearer to him was a Jap officer gesticulating to his men in an effort to reorganize them, but not a man but himself was standing up.

"Here's a rescue, Berger!" shouted Cawthorne, as a big aeroplane glided to the ground close by, and he saw the khaki uniforms.

Instantly a lieutenant sprang out and ran over to them.

"We've room for your party, Captain Cawthorne. You can do nothing more here, I suppose," with a glance at the smashed gyroplane.

Cawthorne looked at Berger, who nodded, and then said:

"One of our men is injured. Is it possible to carry him out of this?"

"Here's another aero coming," replied the lieutenant. "Hi! What's this mean!"

A hundred rods to one side a number of armed Japs were rushing towards them. Cawthorne's party drew close together, revolvers in hand.

"Hold your fire 'til they're within a hundred feet!" commanded Berger, but the next moment Kilroth gave a fearful shriek, sprang four feet in the air, his arms waving wildly, and as he came down, he clutched at the wheel of a gun and clung to it, still howling.

The effect on the Japs was instantaneous and astoundingly effective. Everyone of them was groveling on his belly, clutching at brush, at rocks, at the hair or arms of his fellows, at anything for an anchorage to his dear old Mother Earth.

Kilroth doubled up in a paroxism of laughter, the contagion of which spread to the others.

"Pick up that wounded man!" shouted a voice, and they lifted him into the frame of the second aeroplane. Another instant they were all again in the air, sailing at full speed towards headquarters, while the Japanese officer was leaping among his prostrate men, striking them with the flat of his sword and using language which was perhaps appealing eloquence, but was certainly decorated with an unlimited assortment of profane trimmings.

"Marvelous! marvelous!" muttered General Illington as he heard their report. "Two hundred thousand of the enemy routed, and not one of your men lost!"

"One man injured!" grinned Cawthorne, "and we brought him out."

"The loss of the gyroplane is serious," muttered the general. "The enemy may rally before we get our bridge across; it will take fully an hour, yet; even if the engineers are not attacked by shell."

Captain saluted: "I think, general, that there isn't a gun over there in condition to go into action without repairs or adjustments."

"Have the other gyroplanes left Denver yet?" asked Cawthorne.

The general growled: "A report came in just before you arrived that the train had reached Valencio. But it adds that the line is terribly congested and that the train cannot reach here for 40 or 50 hours—perhaps longer!"

"Valencio!" muttered Cawthorne, "that's 400 miles. An aeroplane could make it in five hours, or less; we could assemble a machine in two hours and bring it here in another five. Twelve or 15 hours at the most, general!"

"Do it!" exclaimed the general. "I'll order those cars sidetracked at—er—Captain Berger, find out what station that train will reach five hours hence, and dispatch orders to drop those three cars there!" Then turning to Cawthorne: "The enemy has heavy reinforcements coming up, within a hundred and fifty miles of the river; and you'd be back in time to meet them. Take all the men you need and return with the first machine you can get together!"

Then he turned with a chuckling grin to Kilroth.

"You, my nullifier impersonator, can, I suppose, assemble the other machines and bring them to the front without delay?"

Kilroth grinned and bowed. Ten minutes later the party, with four skilled mechanics, were sailing north.

* * *

Coming northeast from Guaymas Bay, in the Gulf of California, was the main army of the Japo-Chinee-Mexican alliance. Almost in sight of each other train sections were crawling along the railroad, bringing up heavy field guns, aeroplanes, munitions, supplies and men. On the trails and plains mounted Mexicans of Cabellero's and Valejo's commands were advancing, devastating every ranch, village and town on the 10-mile wide trail.

The head of this army had reached Guadeloupe, 40 miles from the Rio Grande, and had encamped there waiting for more forces to come up; but when the amazing news arrived of the mysterious disaster at the front, they were again put on the march. Presently fugitives from the river straggled in, amazing and terrifying the new men with stories of their flotations.

A great group of aeroplanes appeared, three or four thousand feet above, for excepting a few held back for scouting purposes, every airship in Illington's division was escorting the G.N.2. Hovering about them at respectful distances were a few of the Japo-Chinee airships, and occasional flashes from guns showed spasmodic attempts at interference.

Presently there dropped on the advancing troops small pellets of metal which, coming from so great a height, caused severe wounds on the few men they happened to hit. Then one gyroplane—the G. N 2—darted below the others and glided directly over the column of troops beneath.

Again were the astounding conditions and demoralization at the Rio Grande repeated; but as there was not the slightest breeze the effects were not quite so evident to Cawthorne's party. Men lifting their feet to the march step were unable to replace them with any accuracy and would stagger or drift against each other in utter helplessness. Horses hauling heavy guns and baggage wagons suddenly plunged ahead as all weight behind vanished and then reared and sought in vain for secure footing. In an instant, as the gyroplane glided slowly over them, all order, all discipline and all courage disappeared. Men fluttered along the ground—sometimes head down, sometimes half a dozen clutch-

(*Continued on page* 300.)

YOU have read, of course, Mr. Stratton's interesting story "Omegon," last month. Here's the continuation: This story is as startling as it is original; moreover it is exceedingly timely and it may sound far more impossible than it really is, for Professor Thomas Jefferson Jackson See, of the Naval Observatory at Mare Island, Cal., has just announced one of the most important and momentous discoveries of the age. He claims that gravity is but another electrical phenomenon caused by electrical currents circulating about atoms of matter. If this is really so—and we have no reason to doubt the new theory—then Mr. Stratton's story is not only probable, but highly possible.

You must read this tale by all means.

Conserving Uncle George

By Thomas Reed

YOU know that gentleman by the name of Sloyd? He was the apostle of Care and Pains. If you are making a joint, he says fuss over it as though all the joiners of Joinville were watching you with their eyes bulging out. And don't you dare to fudge it up.

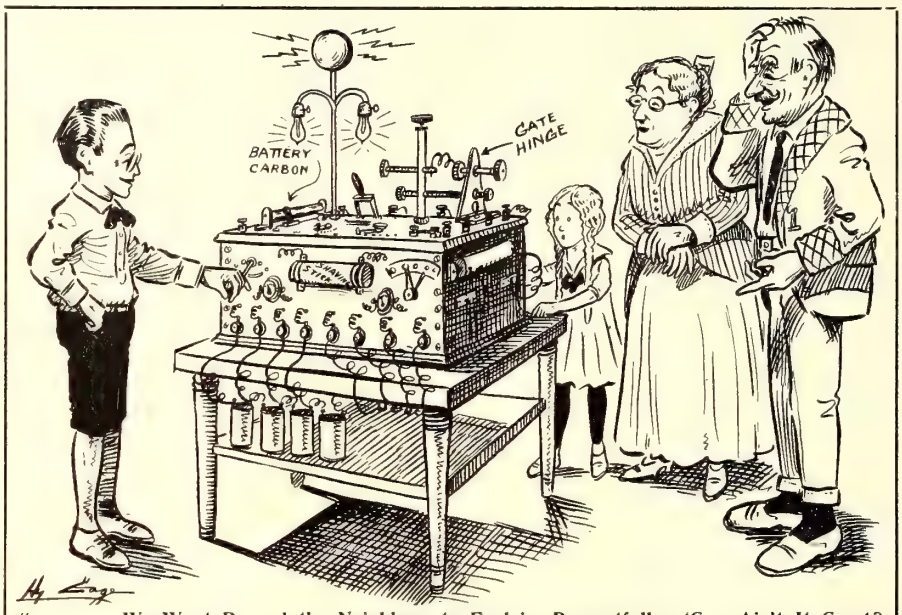
The article you are making is not so important. You simply think up something to make that will have to have a joint on it. Say you decide on a nice knife-tray for mother. Mother would rather have a new set of knives and could keep them any old place; but father missed it on Amalgamated Shoestring Common and can't see the knives just now. Sorry. All the same mother pats you on the shoulder and says what a dear, thoughtful boy you are, and the hired girl turns the tray over and uses it to set the garbage pail on. And so it goes.

Sloyd may be all right for certain natures—there's room for lots of things in the world—but the Experimental Bug thinks life is too short for his philosophy. If I confess something don't you tell Gernsback or he'd fire me out of the *E. E.* with a splash, mother's overboard; but I'd rather see an odd contraption rigged up out of a tomato can and three umbrella wires than the most perfect skewangular joint in the world.

Sloyd begins at the back end. You and I start by wanting something and wanting it bad, and then we go to work and make it with what tools and materials we've got. When it's done it may look like a chance grab from the dump, but what of that if it works?

Then if our crude rinktum succeeds, we begin all over again and rebuild it in worthy form—doll it up with a mahogany base and plenty of binding-posts. Even a few superfluous switches and milled nuts are not amiss just to give it tone. Oh I'm wise, I've been there. We want pa and the neighbors to exclaim respectfully, "Gee, ain't it great? what's it for?" instead of smiling scornfully as they recognize the gate-hinge, the dry-battery carbon and the shaving-stick box.

In the chronic state of a boy's exchequer it's a tough choice between tools and materials, because every dollar spent for one means one dollar less for the other. Well, what'll we do about it? Conserve your resources, I say.



". . . . . We Want Pa and the Neighbors to Exclaim Respectfully, 'Gee, Ain't It Great? What's It For?'"

"What's that?" say you, "conserve 'em? They're so small it's as much as I can do to find 'em, let alone that con—con—that phoney word you used." "Well, listen," says I, "part of your resources is Uncle George, isn't it? Don't he generally come across about Christmas time or the birthday? Sure he does. Then he's a resource and you want to conserve him."

Now it's this way: Don't tap Uncle George for materials, but let him buy the tools. The little roll of that silk-covered wire that you want so much wouldn't appeal to him. It disappears and he thinks you're extravagant, and extravagance is bad for you. What he wants to give you is something large and shiny—something you can pick up any time and say with tears of gratitude in your eyes, "Uncle George gave me that."

Well, humor him—that's the way we old fellows get to be so awful rich. Pretty soon Uncle George will begin testing out the ground in the guise of advance agent of S. Claus & Co., Ltd. Now don't let him, in his ignorance, blow you to one of those so-called tool-chests at which a pound of cheese would laugh. What do you want of a young tack-hammer, a chalkline, plumb-bob and a square that isn't square? No, sir, hand it to him straight about the drill and the center-punch and the hack-saw. Head him off from one of those things you can imitate a suspension bridge or a flying-machine with. If he commences to talk in two figures like a sport, you can suggest that he who passes along a good lathe would surely avoid the appearance of a piker.

Here's a list of tools you want—tools to use, not to form a museum with. Paste it in Uncle George's hat or on his eyebrow, and you will never regret it, though he may. I don't include the necessary hammer, saw, plane, etc., as I assume you have pinched father's!

Hand drill, $1.25; hacksaw, 50c.; hand beading tool, $1; center punch, 10c.; metal shears, 50c.; pliers, 25c.; iron rabbit-plane, $1; marking gauge, 25c.; iron vise, 3-in. jaw, $1.50; miter-box, $4.50; ratchet bit-stock, $1; countersink, 10c.; hand emery-wheel, $1.29; compass saw, 25c.; oilstone, 25c.; lathe, $40; bench vise screw (make your own jaws), 50c.; files, flat and half round, 25c. each; twist drills, 1/16 to 3/16 by 64ths, about $1; wood bits, 1/4, 3/8 and 1/2 in., 25c. each; expansion bit, 1/2 to 1 1/2 in., 75c.; 8/32 tap and die, with die stock, $1.50; tool handle with enclosed awl points, etc., 25 to 75c.

Hits any mark from a tightwad to a joy-rider, eh, Bugs?

PROF. SEE CLAIMS TO KNOW CAUSE OF GRAVITATION.

Dr. Howard D. Minchin, of the University of Rochester, will inquire into the announcement of Prof. Thomas Jefferson Jackson See, one of the best-known astronomers and mathematicians in the United States and at present in charge of the Naval Observatory at Mare Island, Cal., that he has discovered the cause of gravitation. Students in science are greatly interested in the announcement coming from a man of such standing. Dr. Minchin said he could not intelligently comment on the discovery until he had investigated.

Professor See contends that gravitation is an electrical phenomenon which is caused by elementary electrical currents circulating about atoms of matter. The theory of Professor See is an extension and elaboration of physical laws first demonstrated by the French physicist, Ampere, 95 years ago. Ampere, whose name has been taken to denote the unit of electrical current, showed that two parallel currents of electricity flowing in the same direction attract each other, but repel when flowing in opposite directions.

The more atomic electric currents around one body of matter flowing in the same direction as the atomic currents in an adjacent body the more the two bodies will be attracted, Professor See contends, and this mutual attraction is nothing more nor less than gravity.

Gravitation, Professor See contends, does not act instantly across space, but is transmitted with the velocity of light. Thus it would come from the sun to the earth in eight minutes.

Professor See's treatise on his discovery is in the possession of the Royal Society of London. It was to this society that Sir Isaac Newton announced his laws of gravitation in 1685. The society has not yet passed upon the theory.

U. S. NAVAL RADIO SCHEMES PROGRESS.

The naval radio construction program of the Government has gone far enough to warrant the statement that it is to be carried forward to completion without exceeding the $1,500,000 limit of cost fixed by Congress. The system when in operation, it will be recalled, is to circle the globe, giving the American Government at Washington, D. C., direct control of its battleships, no matter in what part of the world they may be located.

The fund has been used in the construction and equipment of the naval radio station on the Canal Zone, which is now in operation; and is being used for the stations at San Diego and Honolulu, where work has begun; at Cavite, where arrangements for construction are under way, and at Guam, where the project is in the initial stage.

Can Electricity Transfer Thought Waves?

WHETHER electricity can or cannot transfer thought waves from one human brain to another is a much mooted question which has for some time occupied the minds of many of the foremost scientists in the old and new worlds. Among some of the more well-known and brilliant men who have seriously considered this matter there may be mentioned Thomas A. Edison, Sir Oliver Lodge and Prof. Alexander Graham Bell.

This whole subject revolves in a way about the science of psychic phenomena, it may be said, and this branch of little understood science considers as an absolute fact that "thoughts can be transferred from one mind to another," and in many cases workers in this branch of *science* (shall we call it science?) even claim to communicate with the departed spirits of deceased persons.

While most of us, in view of the present great intellectual activities and enlightenment of the day, are prone to scoff at all such theories and alleged demonstrations of a new art, it seemingly behooves us to think over the matter more than once, when such great scientific investigators as Bell, Edison and Lodge will condescend to look into such things seriously.

At a recent meeting of the American Institute of Electrical Engineers at New York City, where Dr. Bell, inventor of the telephone, was presented with the Edison medal "For Meritorious Achievement in Electrical Science," he, in response to the presentation address accompanying the gift of the medal, spoke as follows:

"What will come next? We now have electric light, electric power, electric speech and a swarm of electric appliances that have come into use during recent years. All of our knowledge of the external universe is derived from our senses, and science has brought electricity to the service of practically all of our senses. Are you going on? The possibilities of further development are inconceivable."

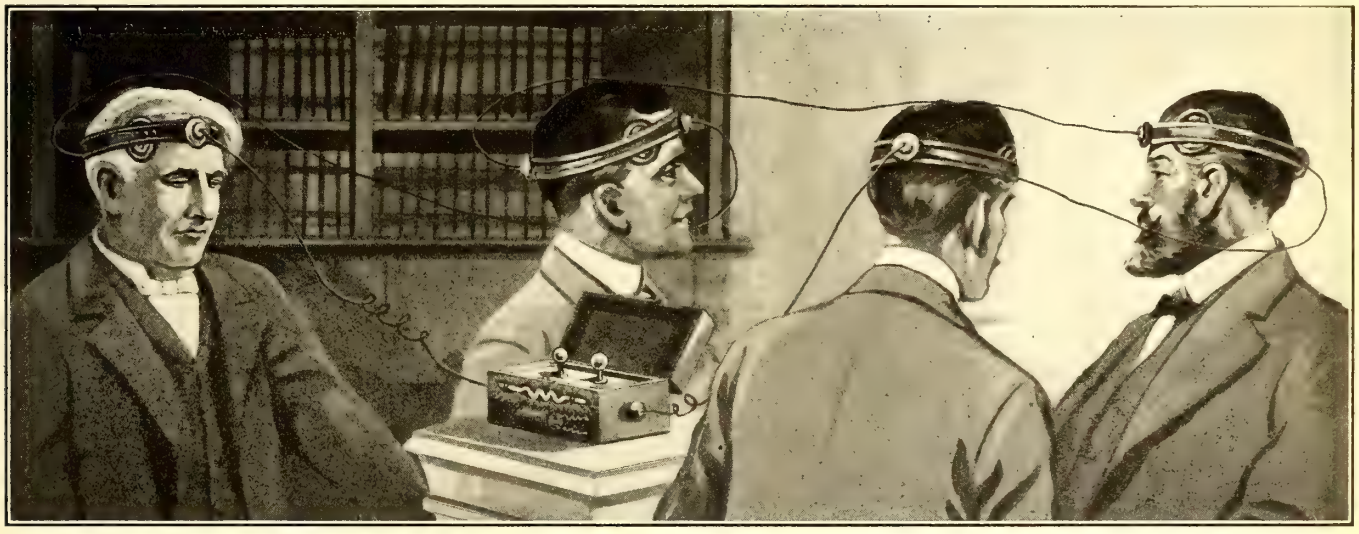
"Men can do nearly everything else by electricity already, and I can imagine them with coils of wire about their heads coming together for communication of thought by induction."

The audience of 1,000 electrical engineers and their guests showed no sign of being incredulous, even of this suggested possibility of electrical development. However, Dr. Bell added:

"But that is for you to make possible," with emphasis on the "you," and when the laughter had subsided he continued: "I have been struck by the fact that nearly all of the recent steps have had to do with vibrations. Suppose you have the power to make an iron rod vibrate with any desired frequency in a dark room. At first, when vibrating slowly, its movement will be indicated by only one sense, that of *touch*. Soon, as the vibrations increase, a low *sound* will emanate from it, and it will appeal to *two* senses. At about 32,000 vibrations to the second the sound will be loud and shrill, but at 40,000 vibrations it will be silent, and its movement will not be indicated by touch. Its movement will be indicated by no ordinary human sense. At 100,000, up to about 1,500,000 vibrations per second, we have no sense that can appreciate any effect. After that stage its movement is indicated first by the sense of *temperature*, and then, when the rod becomes red hot, by the sense of *sight*. At 3,000,000 it sheds violet light."

"Now the thought has occurred to me that there must be a great deal to be learned about the effect of those vibrations in the great gap where the ordinary human senses are unable to *hear, see* or *feel the movement*. The power to send wireless messages by etheric vibrations lies in that gap, but the gap is so great that it seems there must be more. You must make machines practically to supply new senses, as the wireless instruments do. Can it be said, when you think of that great gap, that there is no field in the further development of electrical science for you?"

The illustration herewith gives an idea of how the inductance coils proposed by Dr. Bell would appear on the head for the transmission and reception of thought waves from the human brains.



Will the Day Come When Even Our "Thoughts" Can Be Transmitted From One Brain to Another, Electrically?

Sir Oliver Lodge, in dealing with the development of news intelligence transmission has declared that it is not unreasonable to say we will eventually become so developed that one man may call another by name, seeking to find him among the millions of the world's population, and if that man answereth not then he must be no more in the flesh. This, indeed, seems to be one of the wonderful objectives toward which modern scientific investigation is directed.

Dr. Alexander Graham Bell has already experimented on the transmission of thought over long distances by means of electrical induction. The inventor of the telephone and his assistant, Prof. Ellis, capped their heads with improvised induction coils, but the only result of the brief first experiment—revealed by chance two years later—was that, while there was no transmission of thought, the sensation of nausea that afflicted Ellis at the time was communicated to Dr. Bell, a fact that he readily recalled when, in discussing the test after the lapse of time, the professor said he did not consider it a fair trial because he had a sick headache and a feeling of nausea. Dr. Bell thinks that it may be that various sensations can thus be more readily communicated than thought, and he expects at some future time to begin a more thorough experimentation.

Thomas A. Edison, the wizard of all inventors and probably the foremost American scientist, has been much impressed by some of this so-called *mental telepathic* or *thought wave* transmission, and particularly by one expert by the name of Mr. Bert Reese. Mr. Edison made a number of different rigid tests in connection with Mr. Reese, and also he made several experiments between the expert and employes at the Edison plant. Mr. Edison says of this matter: "Then I asked him to let me try. In my case I went into another building and wrote down the words 'Is there anything better than nickel hydroxide for an alkaline storage battery?'

"At that time I was experimenting with my new storage battery and felt somewhat dubious about being on the right track. In the meantime as I folded the slip of paper containing the above words in writing I filled my mind with a different problem and kept working on its solution so that Reese could not by 'mind-reading' decipher what I had written on the slip of paper, and returned to the room where I had left Reese. At the moment I entered the room he said: 'No there is nothing better than nickel hydroxide for an alkaline storage battery.'

"He had therefore read my question accurately, and to this day I am satisfied that there is nothing better than nickel hydroxide for that particular purpose.

"About two years afterward the boy from the gate-house of my laboratory came in and announced that Reese was in the gate-house and wanted to see me. I took out my pencil and wrote in microscopic letters the word 'keno.' I folded the paper, put it in my pocket and then told the boy to bring Reese in. I greeted him and at once said: 'Reese, I have a slip of paper

(*Continued on page* 254.)

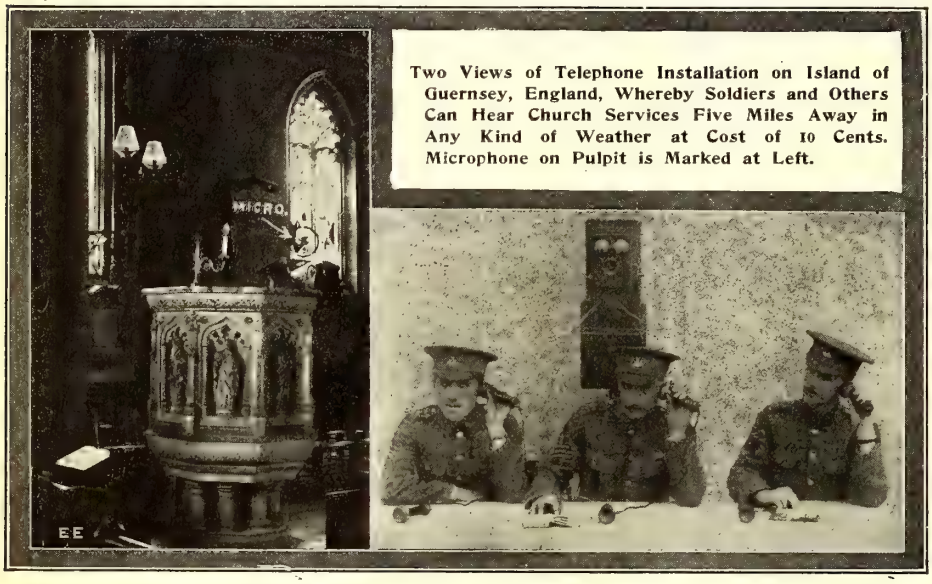
CHURCH SERVICE BY TELEPHONE.

By E. O. Catford.

In Guernsey, England, if a Sunday happens to be disturbed by the elements, the populace can remain at home by their comfortable hearth and listen to the sermon, the organ and choir instead of tramping through the rain or snow, as the case may be, and then arriving at the church in so irritable and distressed a condition that they can hardly and whole-heartedly participate in the church service.

This is accomplished by having the telephone exchange connect you to the church by a switch. The charge for this service is 10 cents, but public officials, such as police, firemen, militia and others, who are kept from church services by their duties, are given the privilege free of charge.

At Platte Fougère Light-house Station (Guernsey), where these photos were taken, frequently as many as eight persons sit around the table on a Sunday evening, listening to the minister's sermon five miles away.



Two Views of Telephone Installation on Island of Guernsey, England, Whereby Soldiers and Others Can Hear Church Services Five Miles Away in Any Kind of Weather at Cost of 10 Cents. Microphone on Pulpit is Marked at Left.

TESLA SUES MARCONI FOR WIRELESS CONTROL.

Nikola Tesla has appealed to the law to declare that he and not William Marconi is the inventor of wireless telegraphy. Many millions in money and world-wide control of the commercial use of the wireless transmission of energy are involved in the struggle.

The suit has been brought in the United States District Court in the name of the Nikola Tesla Co., of which the Serbian inventor is the president, and to which he has transferred all of his fundamental patent rights in wireless telegraphy. The defendant in the action is the Marconi Wireless Telegraph Co. of America.

Mr. Tesla announced recently in connection with the suit that he has just been granted a patent by the United States Government which will supersede and revolutionize all present forms and applications of wireless telegraphy and will enable him and the financiers who are associated with him to obtain and keep a hold on commercial wireless telegraphy, no matter what may be the outcome of the litigation he has begun against the Marconi interests.

"My earlier experiments in Colorado in 1899," he said, "demonstrated that I was on the right track, and with a transmitter of my invention of not more than 30 inches in diameter I succeeded in concentrating and applying an amount of electrical energy twice as strong as is contained in an ordinary stroke of lightning.

"Since then I have pursued my experiments with that one point in view, namely, the discovery of a way of concentrating and absolutely controlling electrical energy. This result has been attained under the workings of the apparatus for which the Government granted me a patent last December.

"I now claim that I can confine any amount of electrical energy, and that, too, without the use of insulation. The Marconi and other existing systems of wireless telegraphy require that there shall be insulation in connection with the transmitter. I can now send a wireless current entirely across the ocean.

"In transmitting a Marconi wireless current, for example, not more than 20 or 30 horsepower of energy is required; with my new apparatus I can concentrate and direct 5,000 horsepower of electrical energy.

"With this tremendous energy thus concentrated and controlled I can telephone by wireless across the ocean. I can use the apparatus, also, for sending a blaze of light over great distances."

Mr. Tesla in the complaint alleges that he is the inventor of a system of transmission of electrical energy and of apparatus arranged for that method and system, for which he received a patent, numbered 645,576, applied for on Sept. 2, 1897, and issued March 20, 1900, and for which he also received a patent, numbered 649,621, applied for at the same time as the other, and issued by the commissioner on May 15, 1900.

Marconi's application for a patent on wireless telegraphy, the complaint asserts, was filed on Nov. 10, 1900, and was not granted and issued until June 28, 1904, being numbered 763,772.

The Tesla company asks the court to declare the Marconi wireless telegraph patent null and void, claiming that the Marconi patent covers the inventions and combinations of apparatus described and claimed in the Tesla patents.

The Marconi company has put in an answer denying any infringement.

The Tesla company also has begun a suit against the Marconi company for alleged infringement of the Tesla patents.

[*Ed. Note.—Tesla's patents and wireless transmission of energy are covered in "Wireless Telegraphy" by Sewall, procurable from our Book Department at* $2.15 *prepaid.*]

CAN ELECTRICITY TRANSFER THOUGHT WAVES?

(*Continued from page* 253.)

in my pocket, what is on it?' Without a moment's hesitation he said 'keno.'"

Mr. H. Gernsback, who has studied considerably such matters as mental telepathy and also such matters as "thought transmission" in so far as the matter can be studied at this time, has made a suggestion which may be mentioned as worthy of trial in this field. This suggestion embodies the use of a set of one or more sensitive Thermo-couples, which, as we know, produce an electric current whenever they are heated. It has been found that invariably whenever the brain is concentrated on some problem, or thought, that heat is produced in such a way that it will cause the forehead of a person to perspire, even though slightly. Now if this Thermo-couple arrangement is placed against the forehead there is a possibility that waves might be picked up and transmitted over a wire to a proper receiving apparatus or instrument attached to the head of a second person.

A theory promulgated by Mr. H. W. Secor takes for its basis a somewhat different phenomena. This particular action is nothing more nor less than the *Aurora,* which we know exists for quite an appreciable distance about the human body. Some time ago a well-known English scientist and investigator made it possible *to view* these vari-colored *aurorae* surrounding the human body by utilizing specially devised screens, and when looking through these screens the ever-changing aurora about the body could be very clearly observed. Moreover, and in line with Mr. Secor's theory, these aurorae are of different colors or hues for different conditions of the mind or brain in the person under observation. They are red, or reddish yellow, when the person is in great anger, and thus they change through various colors for different emotions. If the inductance coils of Dr. Bell, and proposed by him to be strapped around the head, will work at all, it seems very likely that they would act by means of these aurorae discharge from the body and which quite possibly is electrical in its nature. If this is so then a simple coil at both transmitter and receiver end of the line should suffice, as the variation in the electrical *aurorae* setup about the body and controlled by the brain would then induce corresponding ever-changing currents in the first coil to be transmitted over the line to the second coil. This coil could then, in virtue of the fluctuating currents passing through it from the line, influence the *auroral field* about the body of the second person on whose head the coil was placed.

It has been pointed out by several electrical men, and particularly by Dr. Giuseppe Musso, the well-known consulting electrical engineer of New York City, that quite possibly the points at which to apply these transmitting and receiving coils, or other forms of apparatus, is not about the head at all, but at some other vulnerable point or points on the body which would have to be found by experiment, and also in consideration of the fact that these more vulnerable points have the strongest effect on the control of the electric charge on the body. He also has said that in thought transference it has been invariably noted that best results are obtained between two persons having a strong affection for each other, which in another sense might be considered as two minds "in tune" or syntony.

Are you a regular reader? It will pay you to become one!

Electric Toys That Respond To The Voice

ANOTHER novelty for amusing children has arrived in the form of toys, voice operated by electricity. These new toys afford entertainment for

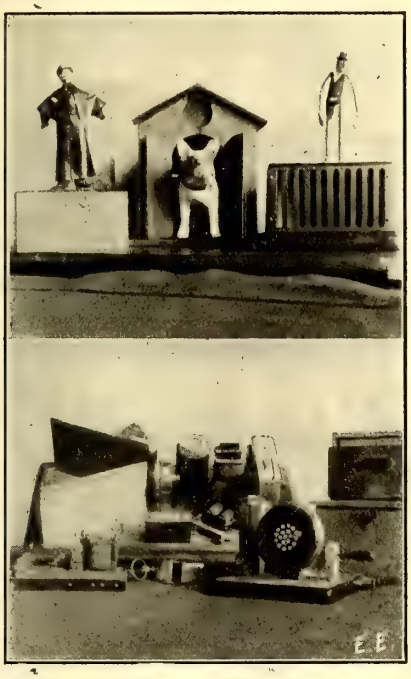


Fig. 1 (Above) Portrays Three Electric Toys Controllable by "Voice." Fig. 3, (Below) Depicts Interior of Toys.

pleasure-loving youngsters as well as the adult, and are operated by sound waves actuating a delicate microphone, by which the various movements of the toy are incited.

The toys herewith illustrated are the results of continuous labor by Mr. H. Christian Berger, the inventor and originator of the submarine wireless system, which was described at length in the August issue of this magazine. These toys in order to operate require solely the human voice or a common whistle. Nor is it necessary to be near the toys; they will operate, for instance, if the whistle is blown 30 feet distant from the apparatus with a result



Fig. 5. At Left Shows Voice Controlled Gun. At Right a Disappearing Satan's Head.

that is as uncanny as it is startling in its novelty.

Fig. 1 represents a group of three electric toys. The one at the left is a *policeman,* enclosed in a case; who, when a certain sound is produced, suddenly jumps up from the case. In the center is a small *dog,* resting in his miniature kennel, the doors of which are closed. As soon as an ordinary whistle is blown the doors open and the little animal jumps out so suddenly that one is almost taken aback at the unexpectedness of his appearance. The third and most interesting is the *dancing coon* seen at the right. This *coon* will perform all kinds of dances as long as the proper tune or sound is produced.

The grate opening in the front of the cabinet is the collector of the sounds which are caused to act on the microphone.

Fig. 2 depicts a schematic diagram of the apparatus used within the dancing doll's abode. M is a microphone connected in series with a battery and relay D, operating a pair of electro-magnets H, which are connected in series with a vibrator L. In operation, when the sound waves strike the microphone M, the resistance of same varies, and the current strength in the magnet D decreases. The armature closes the contacts, X Y, energizing the magnet H, and short-circuit-



Fig. 4. A Whistle Will Fire This Miniature Field Cannon.

ing the microphone. The excitation of the magnet D then again increases and attracts its armature, consequently varying the the fluctuations in electro-magnet H, which in turn operates the doll at Fig. 1, whose hands and feet are made of coiled steel springs. This metal is attracted by magnetism, generated by the electro-magnet H. Also the shoes may be of iron so as to be acted upon by the electro-magnet.

The interior view of these toys is shown at Fig. 3. The apparatus on the right is a microphone relay, operating any electrical device just by the production of *sound,* acting upon the microphone.

The larger instrument, seen in the background of the photograph, is the exact apparatus used in the electric *dancing coon*; while the one towards the left is an automatic controlling relay. The whistle here shown is used as the sound actuator of these novel toys.

Miniature "field guns" are also operated by sound waves, and Fig. 4 illustrates such a gun, which is electrically fired and operated by sounds produced from the whistle shown at the extreme right, near the wagon containing the ordinary instruments used for operating the other toys.

Two very interesting toys are portrayed in Fig. 5; the one at the left, representing

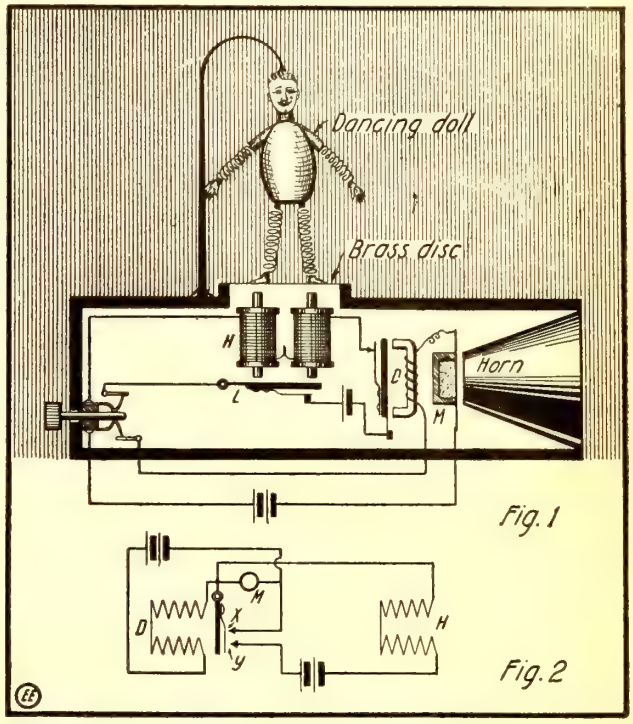


Fig. 2. Diagram of "Dancing Doll" Apparatus Subject to Voice Control.

a device for throwing a "ball" into the air, while the other is a "Satan's Head" concealed in the chimney of the small house, as perceived, who immediately appears at the sound of a voice.

A very suitable toy for Christmas time is illustrated at Fig. 6. This is a tree decorated with miniature electric bulbs, connected to a circuit, including a microphone and batteries, as seen at the left. The lamps on the tree are operated by the microphone whenever sounds are produced by the blowing of the whistle seen in the foreground.

These extremely interesting electric toys



Fig. 6. Electric Lights on Xmas Tree Controllable by Whistle and Microphonic Relay.

mark a distinct advance in the realm of amusement apparatus, and it seems this principle could be well applied further.

A LIGHTHOUSE OPERATED AND CHECKED BY ELECTRICITY.

By Edwin O. Catford.

WHEREVER men are placed in an isolated situation with long continued responsibilities the need for some kind of check or inspection becomes evident. Personal inspection in such cases is necessarily infrequent and therefore inefficient. The men concerned, if they are competent and keen on their work, will welcome any device which is an aid to efficiency.

Some devices of the writer's in use at Platte Fougère Lighthouse Station, Guernsey, England, may be of interest, since they constitute the equivalent to an hourly inspection day and night, year in and year out, with the advantage of automatic and therefore absolutely impartial working.

A clock is provided with a roll of paper attached on which the man on duty records his signature each hour. This clock is also used to note the time of starting and stopping the "fog signal," and in the event of any dispute arising in regard to these times the clock record proves invaluable.

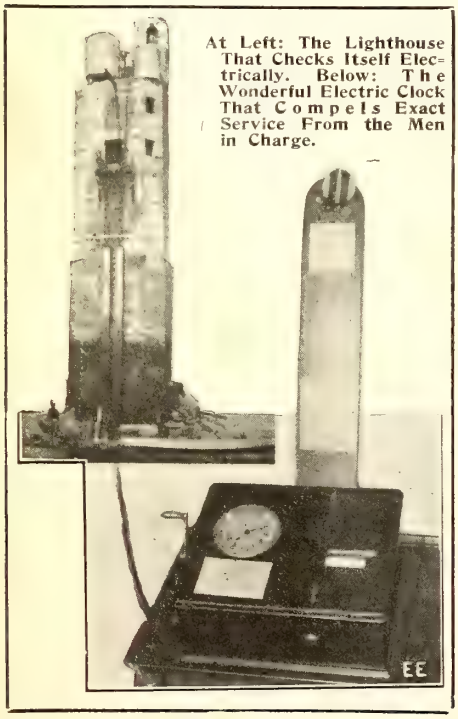
Several electric attachments have been added by the author to this clock.

First, some contacts insure that if the man on duty has not "signed on" the clock will set three electric alarm bells ringing at 20 minutes past the hour.

These bells are situated, respectively, in the engine room and in each of two dwelling houses, so that they serve to call out the keeper who is off duty. Thus this clock may truly be said to be equal to the provision of an hourly inspection day and night.

Should the man on duty meet with an accident during the night, which is always possible with dangerous machinery as used for fog signaling, without these clock attachments he would simply lie until morning with the added probability, almost amounting to certainty, that the machinery also would come to a standstill with the fog still remaining.

The clock insures that should an accident occur which disables the man on duty so that he cannot sign at the clock, at 20 minutes after the next hour the alarm will automatically be raised and the second man called out to duty. Thus by calling aid the clock might save a man's life.



At Left: The Lighthouse That Checks Itself Electrically. Below: The Wonderful Electric Clock That Compels Exact Service From the Men in Charge.

The clock is also a complete safeguard against sleepfulness at night, for which felony it provides instant punishment.

The writer can testify that it is a most disagreeable experience to hear the bells ring out at night and to realize that the whole of your own household, as well as that of your neighbor, has been aroused from sleep by one's own delinquency.

In order to give an indication that the electric alarm attachment is in constant order, it is so arranged that each bell gives a single stroke every hour.

This notifies that all is in order and incidentally shows in both houses that the clock connections have not been tampered with. Twenty minutes later the alarm bells ring out in earnest, unless in the interval the man on duty has "signed on" at the clock.

The recording clock with the author's electric attachment compels the lifting of the clock handle once every hour.

Seizing on this fact it was next arranged that by means of further electric contacts attached to the handle a testing current passes out to the lighthouse through one wire of the cable, returning by another wire, each time the clock is operated; that is, once every hour day and night.

This provides a test for continuity of the cable, it also indicates that the electric lamps and electric lighting circuit are intact and, further, by means of a special pressure gauge on the lighthouse it gives warning ashore when less than a fortnight's supply of acetylene remains for the light.

Double pole contacts are used so that no battery leakage can take place through the cable when the test is not being made. Those who know the insidious electrolytic troubles liable to introduce themselves wherever any continuous leakage of current, however small, becomes possible will appreciate this point.

These indications are useful at all times, but they are doubly appreciated on days and nights when the sea dashes with terrible fury on land and lighthouse, and it is evident that many days must elapse before a visit to the lighthouse will become possible.

To be able then, simply by lifting a handle (in safety) ashore, to obtain assurance as to the condition of affairs on the storm-swept lighthouse is no small gain.

ELECTRIC DENTAL SIGN THAT DEMONSTRATES "BEFORE" AND "AFTER" EFFECTS.

A very pretentious electric sign erected in New York City for a large dental parlor, as shown in illustration and the small insert picture, shows the countenance as it is supposed to appear before visiting the dentist, and the larger photo the satisfied smile and improved appearance of the teeth after taking treatment.

This sign is a large affair and is made entirely of opal glass, which is lighted up from the interior of the sign by means of electric bulbs properly arranged. These are operated by a motor driven flasher, so that the two different faces appear alternately. The features of the countenance where the two teeth are shown missing is also caused to change, so that the general appearance is one of sadness or pain.

This novel electric sign is one of the well-known *Federal* line, and attracts unusual interest in the endless crowds that throng the "Gay White Way" of the Old Town.

Such electric signs as here described are a great improvement upon those of a few years ago, to be sure.



Top View Shows "Before" Appearance of Face, and Lower Illustration, "After" Effect, Produced in New Electric Sign.

LIMIT TUCKERTON WIRELESS.

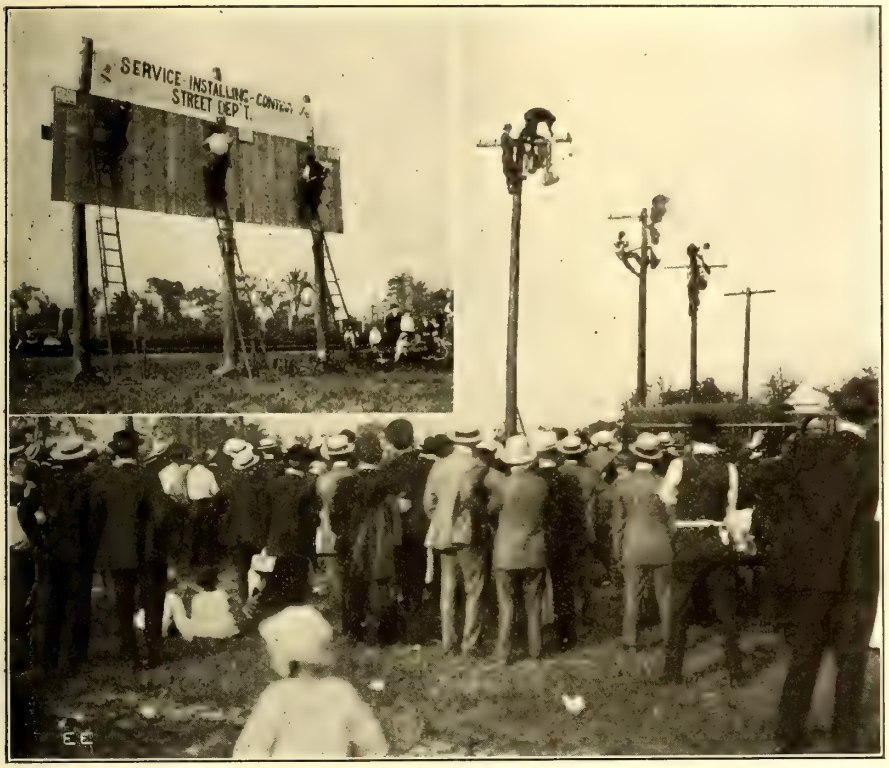
None but Government and Embassy messages will be sent by way of the Tuckerton wireless station until further notice. Messages for Germany and Austria must be forwarded by way of Sayville at the same ra es.

AUTHORS! ATTENTION!

What ideas have you regarding the construction and operation of wireless and electrical apparatus? Why not write up these ideas and experiments for the benefit of the *Electrical Experimenter* readers and thus help yourself and your fellow-worker at the same time. We are pleased to receive contributions of the above character with plain ordinary sketches or photographs and pay regular rates for all such matter published in these columns. Address all communications to the Editor.

Installing A Complete Electric Service in 15 Minutes

As one of the features of the annual field day and outing of the Commonwealth Edison Company, of Chicago, service gangs from each of the company's three overhead districts competed in a service installation contest. The crew representing each district had previously been selected by elimination contests conducted in regular service-installation work during the two weeks preceding the field day.



Insert Above Shows Service Gangs Installing Apparatus in Prize Contest. Lower View Portrays Transformer and Pole Work Contest.

Before the day of the final competition a pole line carrying primary wires on single arms was erected on the field. A platform on which three sections of brick wall were mounted was also erected at a distance of 75 feet from the poles. Above it were placed three regular service outlets connected to groups of lamps. Each gang consisted of a foreman, two linemen and a groundman. The foremen were not allowed to do any work. Sitting in their trucks, which were loaded with standard tools and equipment, the men awaited the signal to start.

The rules of the contest required each crew to do the following work: Cut a gain and bore a hole for a buck arm on the pole; install the buck arm with braces and primary cut-outs; hang a transformer; connect the transformer to the primary circuit and to the service drop; install a bracket with three Pierce bolts on the brick wall; run a 75-foot two-wire service from the pole to the bracket, and connect the service to the outlets. All joints were to be soldered and properly taped. The last thing to be done was to insert the primary plugs to light the lamps above the outlets, indicating that the work had been completed. Any failure to complete the job according to the company's standard practice was to result in a penalty equal to three times the time it would ordinarily take to do that part of the work. Any violation of the company's safety rules was to result in disqualifying the whole gang. Three judges with stop watches took the time and observed the work as it proceeded.

In addition to the prize money offered to the winner of this contest as one of the regular field days events, an added bonus of two cents for each second under 20 minutes was provided for each man in the winning crew.

None of the gangs were disqualified for violating the company's safety rules. The winning crew was, however, penalized 15 seconds for spilling solder.

YACHT'S "MONEL" METAL HULL RUINED BY ELECTROLYSIS.

Alexander Smith Cochran's magnificent schooner yacht "Sea Call," after being in commission only six weeks, is now being broken up for scrap in the yards of her builders at Neponset, Mass.

The "Sea Call" is a splendid sailing yacht with auxiliary gasoline engine. She is being knocked to pieces on account of the disintegration of her bottom through electrical action.

The electrolysis which has damaged the bottom of the boat is said to be due to the use of a steel skeleton and a bottom of monel metal, an expensive alloy composed of, roughly, two parts nickel to one part copper, with small additions of other metals.

It was understood that electrolysis affected the steel skeleton and not the plates of the bottom, but reports from Neponset say that, while the action did start around the stem and stern posts, which are of steel, it resulted in the deterioration of the monel into "a chalky substance." It is said that there are evidences of deterioration in the monel plates of the bottom, but the suggestion has been made that this is only discoloration due to the electrolysis of the steel.

AN ELECTRIC BACTERIOLOGICAL INCUBATOR.

By Frank C. Perkins.

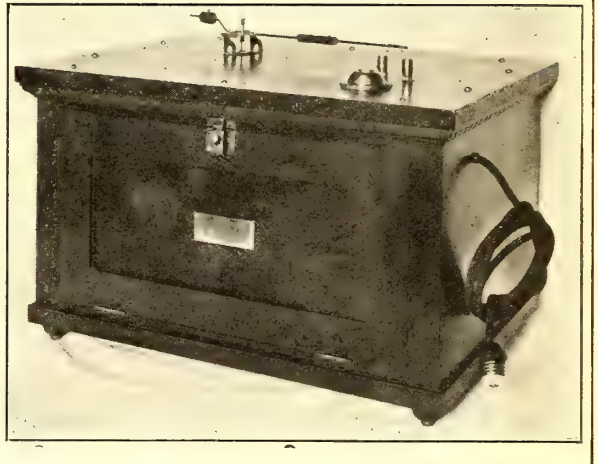
The accompanying illustration shows a most interesting electric bacteriological incubator said to be in advance of the gas-heated devices now generally used on account of the extremely uniform temperature regulation provided.

It was developed at Salt Lake City, Utah, and is so designed that when once adjusted to the desired temperature, it is claimed, it will operate for days at a time without any attention. The incubator is heated with electric resistance coils in the top of the device.

It may be stated that there is a wafer thermostat inside the machine which expands with rise in temperature and pushes a piston stem which raises and lowers a balanced lever arm carrying two electric contact points. These two contact points dip in mercury cups, which are connected in series with one side of the circuit. When the temperature inside the incubator reaches the desired point the contact point is lifted out of the mercury, thus opening the circuit. When the temperature falls just a small fraction of a degree the contact points are lowered back in the mercury and the circuit is closed, thus bringing the machine back to the proper temperature.

It is held that a variation of less than 0.1 degree will cause the device to operate and to open or close the circuit. Temperature adjustment is obtained by means of a small screw. The incubator consists of a double-walled box having a 0.5-inch air space between the outer and inner walls. The box is finished in mahogany and is equipped with double doors, the inner door having a glass panel so that the contents of the machine may be readily inspected without opening the door.

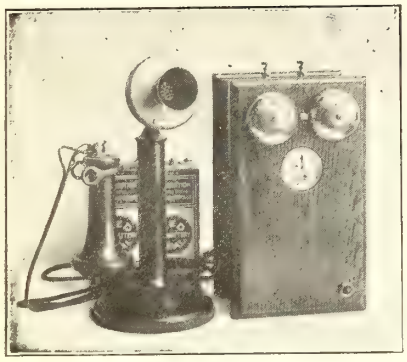
By means of the button seen on top of the machine a miniature lamp inside the incubator can be turned on. The maximum input into the machine is 50 watts, and the average input per hour is about 25 watts. It measures 8 inches in width and 10 inches in height, with a length of 16 inches.



An Automatically Compensated Bacteria Incubator With Electric Heating Coils.

TELEPHONE THAT TELLS WHO CALLED WHILE YOU WERE OUT.

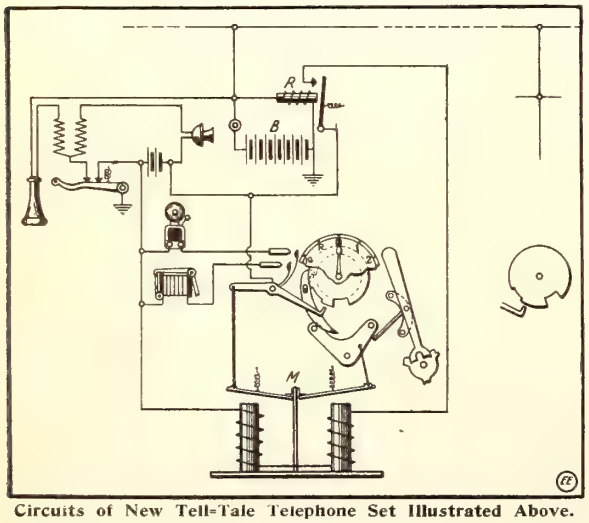
On a single-wire, par -line telephone circuit near Constableville, N. Y., each subscriber is provided with a telephone in-



Novel Telephone Set That Tells Who "Called" While You Were Out.

strument equipped not only with a selective ringing attachment, but also with a device to inform the subscriber who, if anyone, called in his absence. The instruments were constructed under specifications covered in a patent issued to P. G. Bernholtz, Constableville, N. Y. They differ from the standard ground-return telephone in that a special battery has been added to the local circuit and a visual signal or drop, as well as a bell, has been arranged to operate through an especially designed selective-signaling mechanism.

To call a subscriber on a line equipped with these instruments it is necessary to close the special battery (*B*) circuit through the push-button. The special battery operating all relays (*R*) on the line unlocks all instruments. The indicator then moves automatically to the desired number, and when the line is again energized the selective-signaling apparatus in the called subscriber's instrument rings the bell and operates the visual signal or drop. Other instruments return to their normal positions. If it so happens that the called party is not within earshot of the bell, he notes on his return that the visual signal has been operated. He then places his indicator on *R* and energizes the line by means of the special battery, ringing all bells on the line, but failing to actuate any of the visual signals because the indicator was set at position *R*. Hearing this call and observing that the visual signal has not been disturbed, all subscribers understand the signal, and only the one who previously called and failed to obtain the individual with whom he desired to communicate is supposed to answer.



Circuits of New Tell-Tale Telephone Set Illustrated Above.

A Telephonic "Nursemaid" and a Bird Alarm

The accompanying illustration shows the application of the telephone as a nursemaid as devised by an ingenious Englishman. Open air life is undoubtedly best for babies, who indeed, showing a wisdom beyond their years, sleep at once out of doors after strenuously refusing to sleep inside the house. The difficulty has been that where there is no housemaid the busy mother cannot spare time to be constantly outside looking after baby.

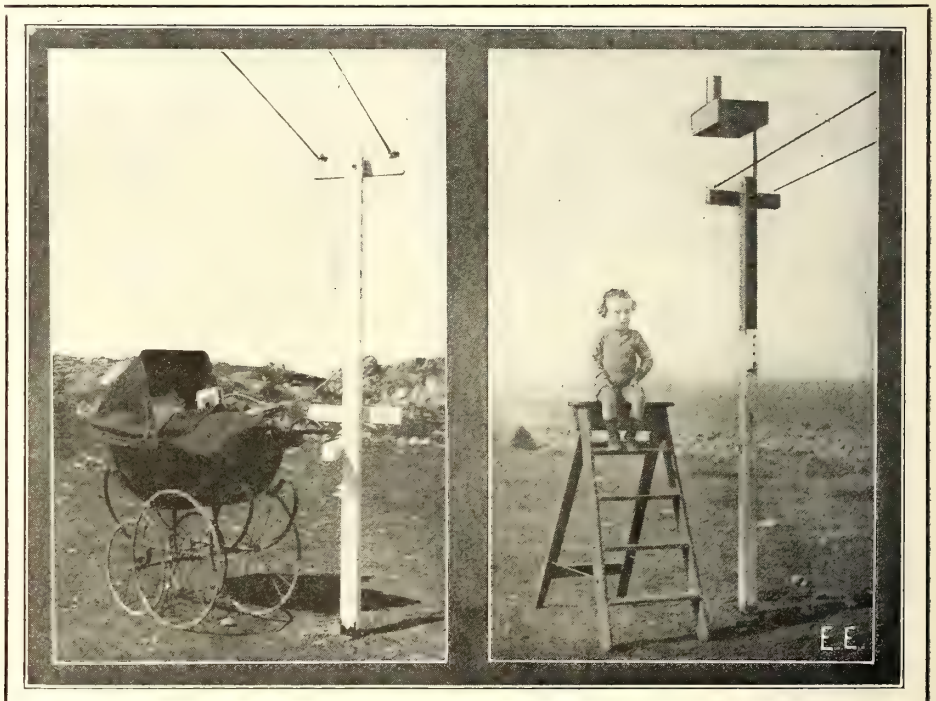
The photograph shows the details of a plan successfully employed by Edwin Catford, the engineer-in-charge at Platte Fougeré lighthouse, Guernsey, where the baby carriage is provided with a cigar box containing a telephone transmitter and a small clock. Wires running up to the house, 20 yards away, enable the mother in the intervals of work to listen for baby's cry; if at the table and during meals it is easy to listen continuously.

A clock attachment was also provided. "No news is good news" does very well as a popular saying, but the electrical engineer knows better, for *no news* often means a hitch in the means of communication. In this case the clock is added so that the sound of its ticking may indicate that the telephone is transmitting sounds correctly. The device proved entirely successful through baby's first year. Not only was baby's cry distinctly heard, but also the comments of persons not knowing of the telephone in the cigar box who approach the spot on the common where baby sleeps. A rain alarm was also evolved to give warning by causing an electric bell to ring should a shower come on.

The second illustration shows an interesting birds' telephone, devised also by E. O. Catford for the benefit of his little son.

As cats kept birds at a distance from the house so that this little boy could not have the pleasure of watching them feed from crumbs thrown out, a cat-proof tray was therefore set up in front of the windows at some distance from the house and here robins, finches and other birds came to feed.

It is of interest to note that the telephone transmitter was then added, so that when the birds sang they could be listened to in the house. Doubtless a better plan would have been to conceal telephone transmitters among the branches of bird-frequented trees, but here there were no trees available. The transmitter in use is the ordinary kind used for speech and is protected from rain by an inverted cocoa tin, well painted, open at the lower end to freely admit sound. After months of this outdoor use the telephone remained in perfect condition.



A Telephone Nurse Maid (at Left) and an Electric Bird Alarm (at Right).

TELEPHONE NEW POLICE AID.

Police Commissioner Arthur Woods announced recently that the New York Telephone Co. will co-operate with the police department in capturing criminals. The territory within 100 miles of New York has been divided into seven zones, and as soon as headquarters notifies the telephone company descriptions of men wanted will be sent to all the zones.

Within a few minutes all chiefs of police, sheriffs, constables and railroad station men can be on the lookout.

WIRELESS AND PIGEONS.

Recent experience has tended to show that carrier pigeons and other birds of passage are guided by magnetic currents. W. A. Thauzies, a French student of pigeons, has noted that on two occasions when pigeon flights were unsatisfactory magnetic storms were occurring; and the flights of these birds have been becoming often uncertain and erratic since wireless telegraphy came into extensive use.

An Electro-Magnetic Nail-Packing Machine

By Frank C. Perkins

THE accompanying illustration, Fig. 1, shows an interesting electro-magnetic nail-packing machine developed at Zurich, Switzerland, while Fig. 2 shows the scheme of packing and indicates the saving accomplished with this orderly method of doing the work as devised by Otto Gamper. Note the new style packages at the right of Fig. 2, containing as many nails as the keg in the center.

One type of this electro-magnetic nail-packing machine is suitable for paralleling and packing nails 2 to 6 inches long, and a special construction for nails 2 to 10 inches long. Until recently, in spite of the fact that for a long time in the nail industry there has been felt the need of a really practical paralleling and packing machine, no one has succeeded in designing an apparatus capable of performing the time-wasting operations of paralleling and packing of nails in a thoroughly satisfactory manner.

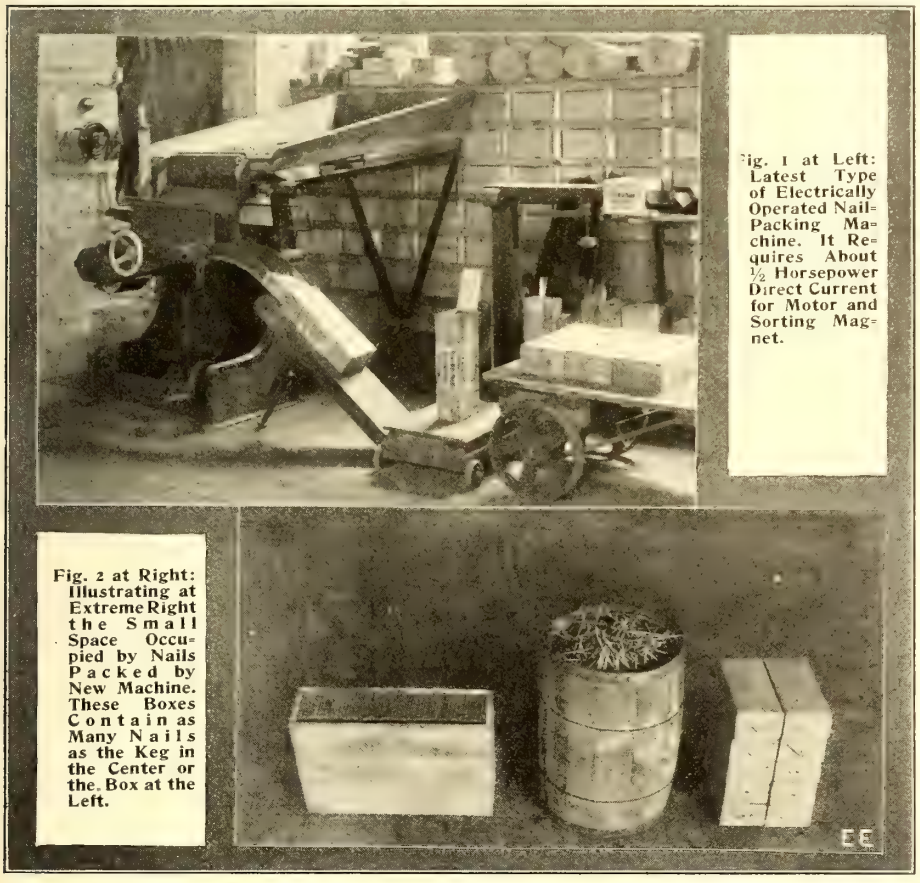


Fig. 1 at Left: Latest Type of Electrically Operated Nail-Packing Machine. It Requires About ½ Horsepower Direct Current for Motor and Sorting Magnet.

Fig. 2 at Right: Illustrating at Extreme Right the Small Space Occupied by Nails Packed by New Machine. These Boxes Contain as Many Nails as the Keg in the Center or the Box at the Left.

This packing machine is based on the principle well known to every electrician, that all linear iron objects, as soon as they are brought into a homogeneous magnetic field, must adjust themselves automatically, under the influence of the magnetizing current, in the direction of the magnetic lines of force, which, as is well known, always run parallel to each other. This being so, it, of course, follows that this machine is not only suited for the paralleling and filling of nails, but that it can be equally well used for packing all magnetically excitable linear objects, such as wire rods, coach screws, hairpins, pens and knife blades.

It will be noted that the machine consists of two main parts, a paralleling mechanism and a feed trough above it, into which a shaking device is fitted. The objects to be packed are emptied into the feed trough in quantities of about 10 cwt., whence through the action of the shaking device they glide gradually into the paralleling mechanism and then, while still falling, are drawn in the direction of the magnetic lines of force. As a consequence they are paralleled in a mathematically exact manner. The objects, thus arranged in parallel and held suspended in the paralleling mechanism by the lines of force, are by means of a lever, which simultaneously cuts out the magnetizing current, pressed into a tray which is fixed between the two magnet poles. This sheet iron tray swings downward, and from it the objects get emptied by a slight jerk into the paper packet, the mouth of which is placed over the end of the tray by the operative in order to receive them.

It is stated that this simple working cycle, making it possible for a girl to attend to the machine, can be repeated so rapidly that one workgirl trained to a certain extent for such work can in one hour deal with ordinary nails of No. 6-6-inch equal to 1,700 to 2,400 pounds in packets of 10 pounds each and No. 10-3½-inch equal to 1,300 to 1,600 pounds, in packets of 7 pounds each, while moulders' nails are handled at the rate of No. 15-6-inch equal to 600 to 800 pounds in packets of 10 pounds each and nearly the same number of packets of 1½-inch, 2-inch, 3-inch and 4-inch nails.

It is claimed that the above quantities represent the following values when compared with those dealt with by hand: Ordinary nails, 4 to 5 times the quantity dealt with by hand, and moulders' nails, 10 to 15 times the quantity dealt with by hand, involving, of course, a corresponding saving in wages.

(*Continued on page* 260.)

WIRELESS ON MOTORCYCLE TO PACIFIC COAST.

By A. J. Geiss.

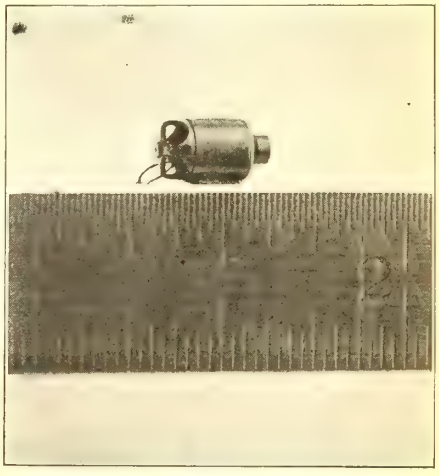
Mr. and Mrs. Wengatz, of Albany, N. Y., passed through Toledo, O., on their way to the Pacific Coast on July 20 last. Mr. Wengatz will be joined later on by Fred Wallace, also of Albany. Their outfit consists of a Dayton motorcycle with side car and trailer. They carry a complete wireless telegraph outfit, and Mr. Wallace, who is a licensed radio operator, will communicate with wireless stations at distant points along their route. They expect to reach the coast in three months, and if the war ends this fall the trio expects to make it a tour of the world.



Wireless Set on Motorcycle Bound for Pacific Coast.

THE SMALLEST ELECTRIC MOTOR.

A motor recently completed by Ivan T. Nedland, a jeweler of North Dakota, weighs only 5.5 grains and is said to be the smallest motor in the world. Its commutator, which measures 0.045 inch in diameter, is made up of four gold segments insulated from each other with mica. No glue or cement was used in its construction. The shaft on which the commutator is mounted is made of steel and is 0.009 inch in diameter. Fiber insulation is used between the commutator and the shaft. The tiny armature, 0.09 inch in diameter, has four pole pieces and is wound with No. 40 silk-covered copper wire. The weight of the revolving part is 1.25 grains. Between the armature and the yoke two field coils are provided. The silver brushes measure 0.012 inch in diameter and are held against the commutator by springs 0.004 inch in diameter. In overall dimensions the motor measures 19/64 inch long and 11/64 inch high. All visible parts are finished in Roman gold. When connected to a small flashlight battery the motor runs at a very high speed.



Said to be the Smallest Electric Motor in the World. It Measures 19/64 Inch Long.

ELECTRICITY ON GERMAN SUBMARINES.

Electricity plays the leading role in the operation and navigation of the modern submarine, the terror of the undersea. The illustration herewith shows the compactly arranged electrical and gasoline engine unit installed in a modern German submarine, half of the hull of the boat being left off, so as to show a sectional view. Those interested would do well to peruse an exhaustive article entitled "Electricity, the Power Behind the Submarine Boat," which appeared in the *July*, 1915, issue of this journal, wherein all of the important functions of the electrical installation of modern submarines are fully discussed and illustrated.

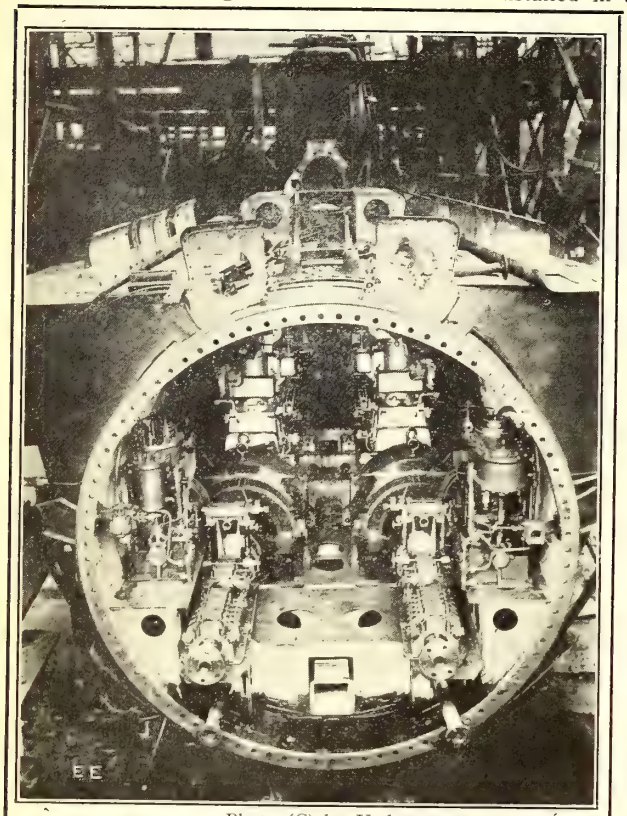


Photo (C) by Underwood & Underwood.

Remarkable Interior View of a German Submarine, Showing the Powerful Electric Motors.

The submarine of to-day is one of the most highly perfected mechanisms ever wrought by the hand of man, and enables the crew of same to sink beneath the surface of the sea and to cruise in this fashion, submerged entirely from sight, for a distance of 100 miles or more, without coming to the surface for air. Special air purifiers and regenerators are provided. Powerful electric storage batteries drive the motors connected to the propellers of the boat when under water. On the surface the gasoline engines are generally used for cruising and, simultaneously, these also drive the motors as dynamos, thus generating current for charging the storage batteries. These boats carry wireless installations of considerable range, as well as the very latest types of submarine signaling devices, operating on *etheric* as well as on the *sound wave* principle, whereby telegraphic signals can be transmitted from one submarine to another through the water and also from a submarine to its mother ship or tender.

The latest vessels of this class have a large cruising range of several thousand miles before returning to their base, and they can be submerged and raised from the sub-surface very rapidly, owing to the ingenious and highly perfected electrical control arrangements provided and which are all quickly available by means of a concentrated group of push buttons at the commander's side, when he is scanning the sea through the periscope for possible victims.

ELECRIC LIGHTING AT PANAMA CANAL.

Our illustration shows the beautiful electrical illumination of the Panama Canal at the Pedro Miguel Locks. The powerful electric lamps are placed on tall concrete columns. The electric current utilized for these lamps is generated at the Gatun Spillway. These ornate lamps serve a double purpose. They permit the passing of the vessels through the canal at night and also make it easier to guard the locks from an attack by an enemy in time of war.



Efficient Electric Lighting Will Help to Guard the Panama Canal.

EDISON'S SECRET.

Thomas A. Edison says new methods of slaughter are in their infancy to-day, but that he cannot find it within himself to work along any line looking to the destruction of life.

He says the possibilities of chemistry and electricity have hardly yet been touched upon in modern warfare, that he knows of more deadly things than the gas bomb that he could invent, "but I can't get myself to work on any such stuff as that. I don't want to destroy life; I want to make the world a better place to live in."

It's a beautiful thought of the great inventor. But maybe in the secret he holds is the awful something that would compel world peace.

HOW "PUSSY" RINGS THE DOOR BELL.

An interesting photograph is shown herewith of an intellectual *cat* owned by Mr. E. L. Catford, of Guernsey (England). The feline announces his desire to enter the kitchen door by sitting on the small shelf observed in the photo. When the cat sits on the shelf an electrical contact spring is closed, which rings the electric bell on the interior of the house.



"Pussy" Gains Admittance by Hopping on this Electric Alarm Shelf.

With very little training this particular member of the cat family soon learned to hop on the shelf whenever it desired to come in, especially during storms, and now makes regular use of the shelf, no matter what kind of weather ensues.

AN ELECTRO-MAGNETIC NAIL-PACKING MACHINE.

(*Continued from page 259.*)

It is pointed out that taking the average reduction in volume to be 50 per cent. for nails arranged in parallel, as compared with such nails shaken loosely into boxes, kegs or barrels, the advantages in connection with packing in boxes and barrels include 30 to 45 per cent. saving of wood through using smaller boxes, kegs or barrels and 10 to 15 per cent. saving in delivery charges through reduced tare, also 40 to 50 per cent. saving in storage.

It is maintained that by using this machine for box filling one obtains 50 per cent. reduction of space with ordinary nails and 70 per cent. reduction of space with moulders' nails, also a 30-45 per cent. saving of wood by using smaller boxes and 10-15 per cent. saving in delivery charges owing to reduced tare.

The electric drive of the machine is of interest. It requires about ½ hp., either from a high-speed line shaft, or where electric driving power is available from a motor erected on the machine. This latter drive is to be preferred because the packing machine is made independent of the line shaft.

The electric current required is small. The feeding of the magnet coils, the current for which amounts to about 1.5 kw. hours per day, takes place by direct connection to an existing direct current supply line having a tension of 110 to 220 volts. Where no direct but alternating current energy is available the necessary direct current is generated by a small converter. If there is no electric energy available the same is generated by a direct current generator mounted on the packing machine. The machine is 5 feet high and takes up a space 6 feet 8 inches to 4 feet 4 inches and its weight is about 13 cwt.

OUR NOVEMBER ISSUE

will contain a wonderful article on "Selenium." You cannot possibly afford to miss it.

NEW SCALE FOR WEIGHING LAMP FILAMENTS.

A precision torsion balance of special design is shown in the illustration herewith. This device is used in general for



Precision Torsion Balance for Weighing Lamp Filaments.

weighing extremely light bodies, but its principal application is in connection with the incandescent lamp industry. In the manufacture of incandescent lamps it is essential that the filament possess certain characteristics, one of which is that its length and, therefore, its weight shall be uniform within certain predetermined limits. While high accuracy is, of course, requisite, the instrument must at the same time be rugged; and these two features are embodied in this instrument.

In use the balance is set on a vibrationless table and carefully leveled by means of the leveling screw and plumb-bob. The *filament* is then hung on the hook which is shown projecting from the right side of the case. The moving element is then freed by manipulating the lever which projects through the bottom of the case just to the left of the vertical support. The large pointer is moved slowly across the scale until the small pointer shown adjacent to the hook comes to the zero point. The indication of the large pointer is then that of the weight of the filament which is being tested.

In actual use the manually operated pointer is set at the presumed weight of the filament, and the position of the small pointer indicates whether the filament is above or below that weight or is exactly the same. These balances are in general use in practically all the lamp factories in this country.

HOW ELECTRICITY GROWS IN SOUTH.

In 10 years South Carolina's jump in consuming electricity by the kilowatt-hour was from 18,000,000 to 356,000,000. This is the largest proportionate gain of any State in the country. New York leads in output of electrical energy, more than 2,000,000,000 kilowatt-hours being used in 1915.

Marconi Heads Wireless Corps of Italian Army.

Signor Guglielmo Marconi, the famous Italian wireless inventor, is seen in our photograph herewith at the key of a large English wireless station located at London. This was taken on his recent trip to England, where he went on special business regarding some new wireless sets he has recently developed for the use of the soldiers in the field and which are said to be small enough and efficient enough to permit officers obtaining information while on the battlefield without utilizing the more cumbersome "trunk" sets making up the regular radio equipment of the signal corps division.

Signor Marconi is at the head of the wireless division of the Italian army and navy and, needless to say, their equipment will be second to none in the great European war.

This master genius has had wonderful opportunities to test out wireless telegraphy over vast distances and with all kinds of apparatus in a more practical way perhaps than has been possible for any other engineer or scientist of our day. It has not always been so, however, as many of our greatest inventors and scientists, notably Hertz, have unfortunately never seen their ideas commercialized to any such extent as has Signor Marconi. The Marconi corporations today operate over the greatest ranges and utilize the very latest apparatus known to the art. Marconi is to Italy what Edison is to the United States. He has rendered a service to mankind that will not be forgotten for centuries to come.

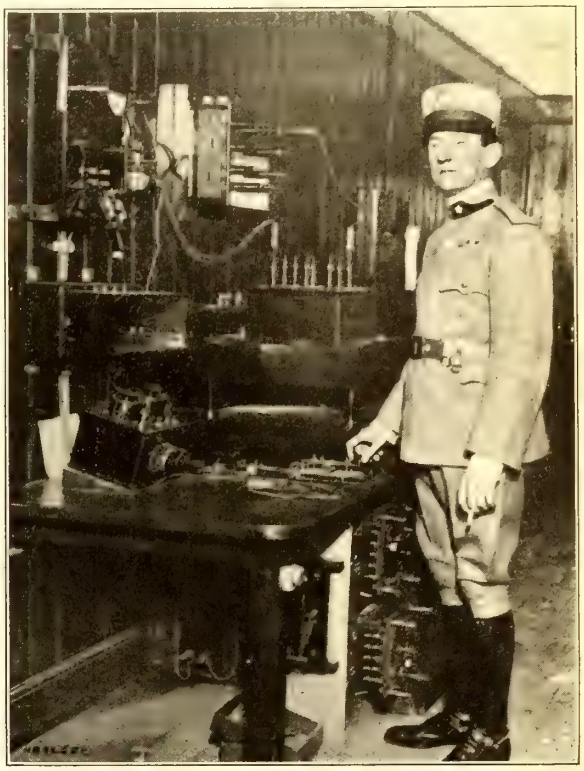


Photo (C) by Underwood & Underwood.

Signor Marconi at the Key of a British Radio Station. A Recent Picture.

COMPLIMENTS ARLINGTON WIRELESS.

Captain Gowan, master of the Johnston liner "Swanmore," at Baltimore, pays a high compliment to the perfect working of the Arlington wireless station. Captain Gowan states that when 1,400 miles off the American coast he is able to catch with great clearness the noon-time signal sent out from Arlington. So clear does the signal come that each tick of it can be heard distinctly. Beyond 1,400 miles the time from the Eiffel tower at Paris is picked up, but it is not clear and often leaves him in doubt about the real time sent out. This superiority of the American station, Captain Gowan said, was not simply at times, but was always so satisfactory that he rated his chronometers by it without a doubt as to accuracy.

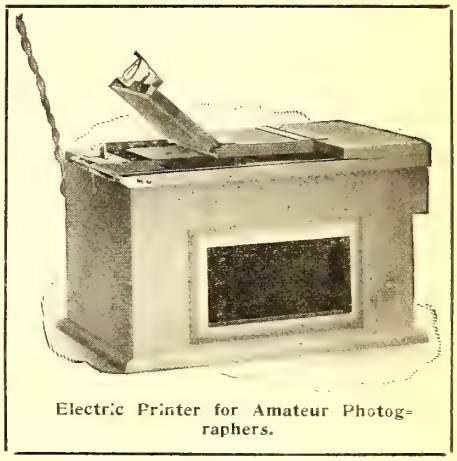
A NEW ELECTRIC PHOTO PRINTER.

The "you-do-the-rest" part is one of the most delightful phases of photography. It is a pleasure, of course, to take pictures, but you are not getting all the fun, all the delight till you *make* them.

For printing there now comes the kodak amateur printer, a new thing—new of necessity embodying, as it does, the very latest ideas in photographic printing.

The printer consists of a box with a removable top in which is located the printing glass. Inside the box are two electric lights —one, a small, red bulb which supplies the necessary illumination for the adjustment of negative and papers, the other, a powerful Mazda lamp which provides the printing light. At the side of the box is a window covered with orange fabric which serves as a dark-room lamp with the red bulb turned on or, with the Mazda lamp, a safe light for Velox developing.

A particular feature is an automatic masking device. Thin metal strips which may be adjusted as desired mask the paper with perfect accuracy, so that prints with white margins may be obtained from any



Electric Printer for Amateur Photographers.

film negatives from the vest pocket up to and including the 4x5 and postcard size. A hinged frame holds the negative and paper tightly together.

The exposure is entirely automatic. When the hinged cover holding the negative and paper is closed the Mazda lamp is automatically turned on, when the catch is released the Mazda lamp is extinguished and the red bulb burns. This arrangement prevents wasted current in making prints.

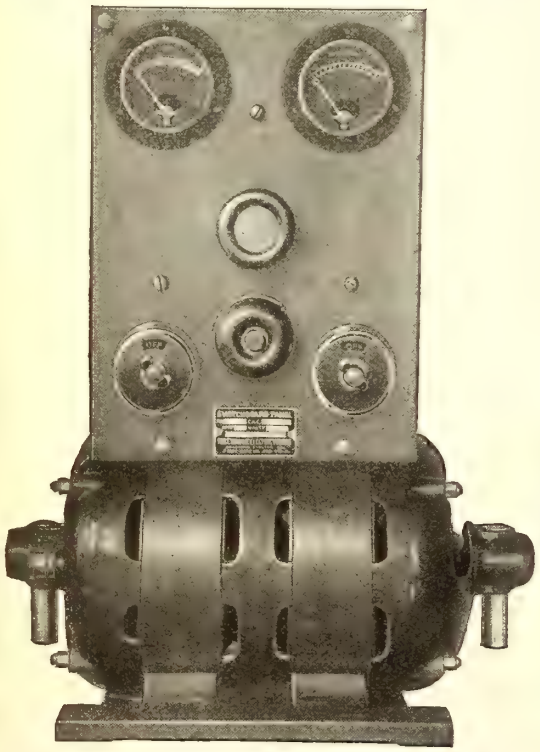
NEW COMPACT BATTERY CHARGING SET.

The new battery charging outfit shown herewith is designed especially for service in garages for charging automobile ignition and lighting batteries. This outfit consists of a small motor-generator set on which is mounted a small switchboard panel bearing all the switches, instruments, etc., necessary for their control. The outfit is to be connected to the incandescent lighting circuit by means of lamp cord and plug, the motor generator being supplied for service on 110 or 220 volt, 60 cycle, alternating current circuit, or on 110 or 220 volt, direct current circuit.

The motor generator is supplied to deliver direct current at 12, 18 or 24 volts, such voltage being specifically adapted for charging 12, 18 and 24 volt batteries.

The switchboard, which is mounted upon these sets, has a snap switch in the line circuit for the purpose of starting and stopping the set; a snap switch in the circuit from the generator to the batteries to be charged, for opening the charging circuit; a voltmeter for reading the voltage delivered by the generator; an ammeter for reading the charging current, and a field rheostat for raising or lowering the voltage of the generator end of the set and, therefore, serving to adjust the battery-charging current.

This set needs practically no attention in service other than an occasional filling of the bearing grease cups with oil. The switchboard, bearing all of the instruments, rheostats, switches, etc, properly wired, leaves as the whole work of installation simply the necessity of connecting to lighting circuit and to battery by lamp cord.



New Compact Type Storage Battery Charging Set.

RESISTANCE OF THE HUMAN BODY.

A human being is not generally looked upon in terms of ohms, yet if a man grasps two oppositely charged terminals, he becomes as much a part of the circuit as the wire itself, and he offers a certain resistance to the flow of current.

It has been estimated by capable authorities that the resistance of the human body is about 10,000 ohms, but it varies greatly with the path the current takes through the body. If a person firmly grasps two metal conductors the resistance from one hand to the other is only from 1,000 to 3,000 ohms. If a shorter path be taken, as for instance through a man's head, the resistance is very much less.

Some interesting experiments have been made relative to the conductivity of the human body, and it has been found, by means of very delicate instruments, that the resistance of the same body varies constantly, even different human moods affecting it.

A change of diet also makes a difference, while such a slight event as a third person entering a room causes a change in the result. One very variable element in the result is the resistance of the skin. When dry, the skin may be regarded almost as an insulator, but by having the pores full of liquid matter the resistance is much reduced.

Nervous people have been found to have a very low resistance, as have also heavy smokers and drinkers.

How The "Movies" Exploit Wireless

We reproduce herewith illustration from one of the popular "movies" of the day, known as the *Romance of Elaine*, in which wireless telegraphy plays an important rôle. The picture in question shows Prof. Arnold, as he is known in the film episode, which is entitled "The Wireless Detective," at the special wireless set on board his yacht. He is seen picking up secret radio signals being sent out from the hidden station of the conspirators, who play an important part in this exciting story.



An Exciting Moment in "Romance of Elaine" Film When the "Wireless" Helps to Locate the Conspirators.

The wireless outfits used are quite ordinary, generally speaking, but in our photo may be seen (at the left) lying on the table an instrument somewhat resembling a Galvanometer. This device is one of Prof. Arnold's marvelous inventions and when connected to any wireless set is supposed to show how far away and exactly in what direction a wireless station lies and from which the signals are being received.

Truly, this is a little ahead of applied science in this direction, as while we have the Radio-Goniometer, which will show quite accurately the direction in which a wireless station lies, we have not as yet any instrument which will show how far away a station is when signals are received from same at any other radio station. Possibly, however, such a device will be used by future radio engineers, and thus it is that the "movies" pave the way unwittingly in scientific advance, so it seems.

INVENTOR CLAIMS TO GET CURRENT FROM AIR.

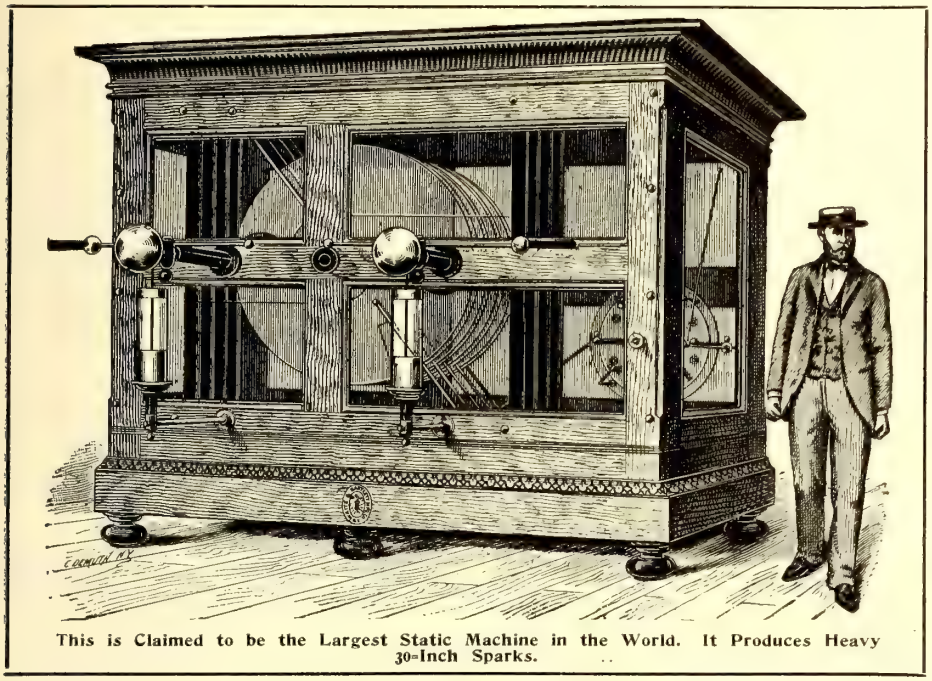
Following the same principles as those involved in wireless telegraphy, A. Bloomfield, an oil district inventor of Pemeta, Okla., claims to have discovered a method of drawing current from the air and successfully propelling a motor without other power. So successful has he been in his demonstrations that the Federal Government has taken it up and has asked the inventor to take his model to the Brooklyn Navy Yard for a test.

The model which Bloomfield has made is a small motor of about one-quarter horsepower. By means of a mast, erected to a height of 75 feet, the current is drawn from the air and the motor is operated.

[Ed.—*Such schemes do not seem to be practical, and we have our doubts about this one.*]

LARGEST STATIC MACHINE IN THE WORLD.

What is claimed to be the largest Holtz type static induction machine in the world is that shown in the illustration herewith. It was built by a well-known New York concern. The relative size of this mastodon of static machines may be judged by the comparative size of the man, shown in the picture. It is in use in the Battle Creek Sanitarium, Battle Creek, Mich., and previous to its installation at that institution it was set up and demonstrated in the laboratory at the College of the City of New York, where its merits and electro-therapeutical properties were explained by Dr. Roger Doremus to countless hundreds of the medical and electro-therapeutical profession.



This is Claimed to be the Largest Static Machine in the World. It Produces Heavy 30-Inch Sparks.

This monster static generator stands 8 feet high and carries eight stationary plates and eight revolving discs. These discs are 60 inches in diameter and they are excited primarily by a small 30-inch plate diameter Töppler-Holtz static machine, which may be observed in one corner of the massive plate glass cabinet, containing the larger machine elements. This machine is capable of producing heavy spark discharges 30 inches long and a wonderful brush discharge of considerably greater length.

LIST OF NEW RADIO STATIONS ANNOUNCED.

The Bureau of Navigation of the United States Department of Commerce announces a list of six additions made to the land stations of the country in the radio service and 16 additional ship stations since its last bulletin on the subject was issued. Of the land stations, the one of longest range is at Tolovana, Alaska, which has a normal reach of 300 nautical miles. The station is located in longitude 149:30 west and latitude 65 north; the wave lengths are 300 and 600 meters, the latter normal, and the system is Telefunken, with 1,000 sparks per second. It is operated by the Alaska Wireless Telegraph Co.

Other land stations established are: Rialto, Cal., 250 miles range; Massie system, 200 per second; wave length, 600 normal, 300 and 1,610; longitude 117:26:53 west, latitude 34:12:08 north; operated by Southern California Edison Co., limited to correspondence with stations of that company. Two at Portland, Ore., each with range of 150 miles; one operated by Charles L. Austin; latitude 45:30:45, longitude 122:42:30 west; limited to correspondence on ships' business with vessels entering and leaving the port of Portland; composite system, 450 per second; wave lengths, 600 normal, 300 and 550; the second, operated by the Northwestern Electric Co., composite system, 400 per second; longitude 122:41 west, latitude 45:32; wave lengths, 600 normal, 300 and 1,700. Fort Adams, R. I., 125 miles range, United States Army system, 500 per second; wave length 1,200; operated and controlled by United States Signal Corps, War Department, and used exclusively for Government business. Marconi station, at Jualin, Alaska, statistics not available.

Of the new ship stations, the largest are the Ossipee and Tallapoosa, each operated and controlled by the United States Coast Guard, Treasury Department, with range of 300 miles, and the Roosevelt, operated and controlled by the Bureau of Fisheries of the Department of Commerce, with a similar range. The Ossipee and Tallapoosa are available for the general public, with rates of 4 cents per word, 40 cents minimum per radiogram.

The Bureau of Navigation has now in the hands of the printer an edition of the "List of Radio Stations of the United States," which will be issued within a short time. Inquiries should be sent to Superintendent of Documents, Washington, D. C.

Watch for wonderful article on "Warfare in the Future" in next issue.

AN EXTREMELY USEFUL HAND MAGNET.

The hand magnet here described is designed for operation on 110 or 220-volt direct-current circuits, and is furnished with a 4-foot length of reinforced flexible cord and a standard attachment plug.

The circuit to the magnetic coils is closed and opened by means of a quick make-and-break snap switch mounted in the handle support. A brass push-button, insulated from the switch, is conveniently located for operation by the thumb when grasping the handle. Pushing the button closes the circuit to the coils and makes the magnet operative. Slight release of the button does not cause the circuit to be opened until the button reaches almost the normal position, when the switch mechanism operates with a quick break and opens the circuit. The magnet then becomes de-energized.

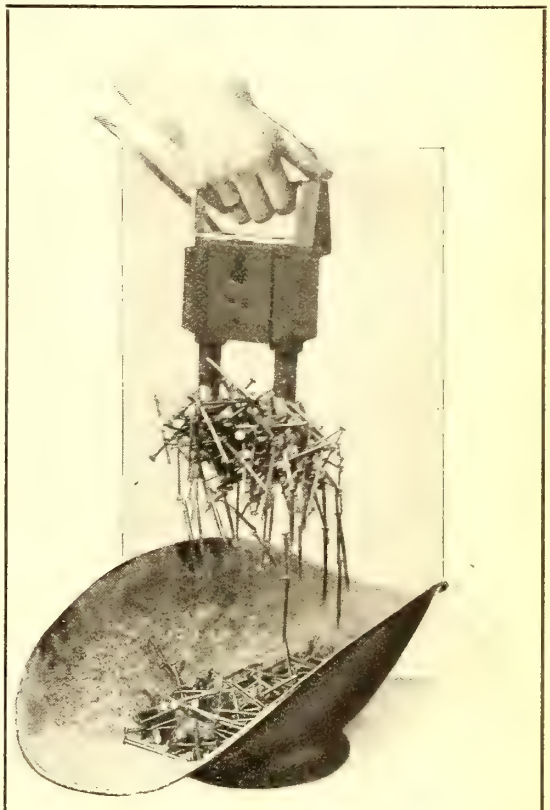
The hand magnet is used in machine shops for clearing chips and borings out of the machinery or removing them from parts of the work not easily accessible. Dropped tools, bolts, boring bars, etc., are easily recovered with the aid of the magnet from places from which it would be difficult to fish them by ordinary means. The weight of the hand-magnet is only 7½ pounds.

In shops where large quantities of brass and iron filings accumulate the hand-magnet is useful since brass being non-magnetic is not attracted by the magnet, like iron, thus enabling the two metals to be separated by merely passing the magnet through the mixed metals.

In foundries this magnet may be used to pick up hot or awkwardly shaped castings; smooth plates, which are sometimes difficult to secure a hold on when lying on a flat surface, or for cleansing the molding sand of minute particles of metal.

Suspended with its two poles immersed in the liquid, the magnet will attract to itself any particles of iron or steel which it may be desired to remove from the tubs in which paints, glazes, chemicals, etc., are mixed. It is also used for dipping can covers, etc.

In the shipping department many hundreds of nails are recovered daily by hand from the sweepings. For work of this sort, or for handling nails, nuts, screws, etc., in hardware stores the hand-magnet is particularly useful.



Useful Hand-Type Electro-Magnet for Lifting Nails, and Other Iron Pieces.

Electric Spark Pictures

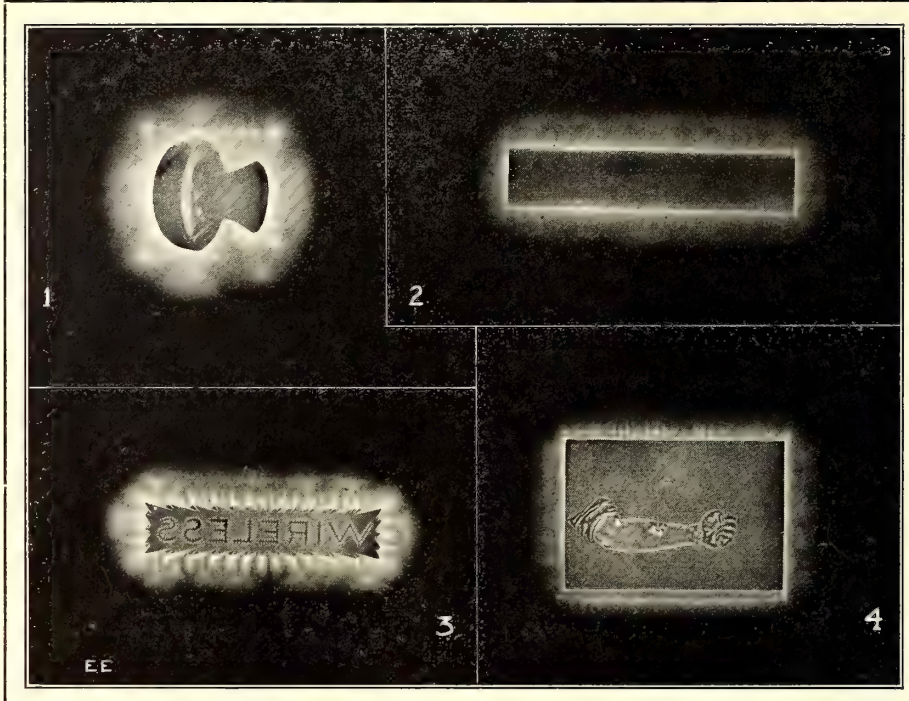
THE illustrations herewith present some new ideas on electric spark pictures.

While electric spark pictures, of course, have been taken right along, our illustrations present some modifications, and in order to show our readers how these pictures are made, a short treatise on the subject will not be amiss. An ordinary spark picture is taken as follows:

Any spark coil from one quarter-inch up to three inches with a fast vibrator should be used. Connect one lead of the secondary terminal to a piece of tin foil or to a piece of sheet metal or metallic plate which should be level. Directly on top of this, with the gelatine side upwards, place an ordinary photographic glass plate. It goes without saying that this operation must be carried on in red light, or else the photographic plate will be spoiled. It is also necessary to carefully blind with black cloth the vibrator of the spark coil so the white spark will not cast light upon the plate.

When everything is ready, take the metallic object which is to be printed by electricity and place it face down directly on top of the photographic plate, so it is in contact with the sensitized gelatine. If the object is square or round without any relief on its face, the negative when developed will show a gray square or a gray round spot. If, however, an object with a relief such as a coin or similar metal object is used, and the plate is developed, subsequently, it will show faithfully all the details which the original article has.

When making spark pictures it should be remembered that a short spark only should be made, and should under no circumstances last longer than a second. Just starting the vibrator for a fraction of a second will usually give best results. Pictures taken with more than two seconds duration usually come out too black.



Some Out of the Ordinary Spark Pictures. (1) Made from Electrotype of Microphone, (2) Steel Rule, (3) Electrotype of "Wireless," (4) Zinc Line Cut of Arm and Hand.

The philosophy of spark pictures is as follows:

When a spark is made the electrical current passes between the object and the metallic plate underneath the photographic plate, the three acting like a condenser.

Wherever the metal touches the plate upon developing the negative will show a black spot at that point. When the negative is printed on paper this process is, of course, reversed, and whatever is black on the plate will be white on the paper and vice versa.

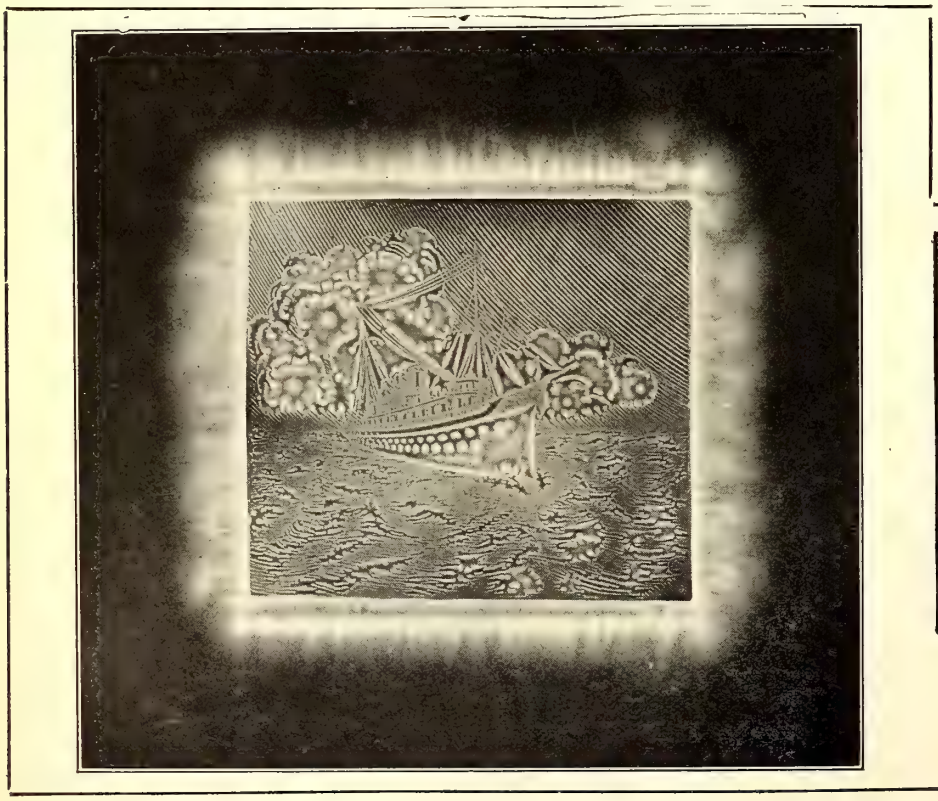
The pictures as shown in this article were taken by H. Gernsback, and the following explanation is given. Up to this time no pictures were known to have been taken of common electrotypes or zinc cuts such as are used for printing purposes, and it occurred to Mr. Gernsback that good results might be obtained if such plates were used. The illustrations show the result.

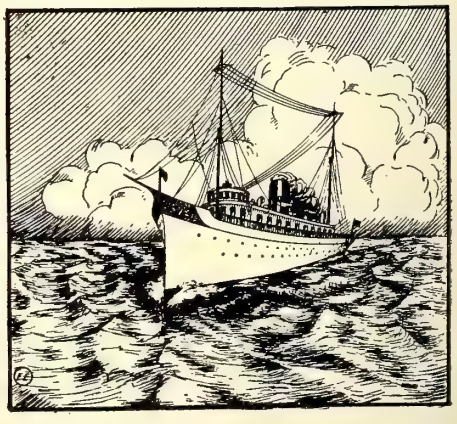
Fig. 1 shows an ordinary line cut, copper electrotype of a microphone which was placed face down upon the plate. The result is clearly shown.

In Fig. 2 an ordinary three-inch steel ruler was used, and in the original photograph all the details down to the division of 1/64 of an inch were clearly shown. These details and also the details of the other three photographs have been lost in the half-tone process by making the plate for printing the illustrations in this magazine.

Fig. 3 shows another copper electrotype with the word "wireless" on it.

Fig. 4 shows an ordinary zinc cut illustration. This cut originally illustrated an article on page 66, June issue of this magazine. It shows much clearer in the orig-





Above: Original Zinc (Line Cut) from Which Spark Picture at Left Was Made.

At Left: Beautiful Spark Photo Made from Zinc Cut Shown at Right. Note Port Holes "Illuminated" by Spark Effect.

inal print. As will be seen, everything is reversed, i.e., white is black and black is white.

The aurorae which show around the illustrations are simply stray sparks during the time the spark was made.

Fig. 5 shows a unique spark picture made with the above process, and this also was a zinc cut, and was originally used in the *Electrical Experimenter,* page 52, June issue. We reproduce the original cut so it may be compared with the spark picture. It will be noted that a curious effect is produced, and attention is called to the port holes which seem lighted up, whereas in the original they only show as points. The explanation is that these sharp points when they made contact with the plate blackened the latter at those points, and when the print was made they, of course, appeared in white. It will be seen that the electrical spark reproduces every detail of the picture down to the most minute detail.

Half-tone cuts were tried but without obtaining results for the reason that the multitude of points which make printing possible were too fine and too near together and the resulting picture therefore appeared simply as a blur.

NEW TALKING MACHINE UTILIZES COMPRESSED AIR AMPLIFIER.

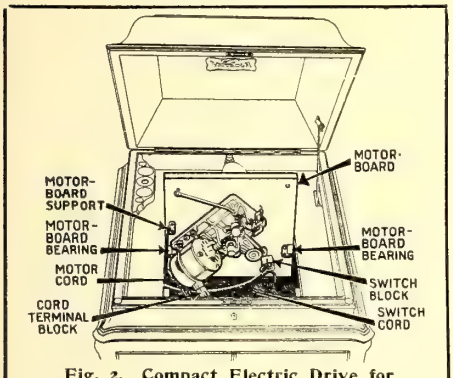


Fig. 2. Compact Electric Drive for Victrolas.

A new talking machine, which is known as the "Auxetophone" and constituting one of the well-known "Victor" line, is shown in our illustration herewith at Fig. 1.

As at present supplied, the Auxetophone constitutes an amplifying phonograph. It utilizes regular disc records, the same as any talking machine of the "Victor" type, and the sounds as given forth from the records and through the regular stylus needle on the phonograph arm are caused to *interact* on a special air valve hooked up with a compressed air tank, as illustration shows.

A compressed-air blower is driven by an electric motor, as perceived, and the machine is equipped either for direct or alternating current, as the service may require.

The motor is directly connected to the blower, which furnishes air for the pneumatic sound-box, in which the volume of the sound is augmented or amplified. An oil condenser is mounted on top of the blower, as shown, which is connected by a flexible tube to an air-pressure equalizing tank. A flexible tube connects to the top of the tank and leads to a filter. From the filter another tube leads off to the taper-arm equipment, which includes the taper tube leading to the horn. The tube is finally connected to a pneumatic sound-box.

The turntable of the machine, which holds the disc records, is in the present

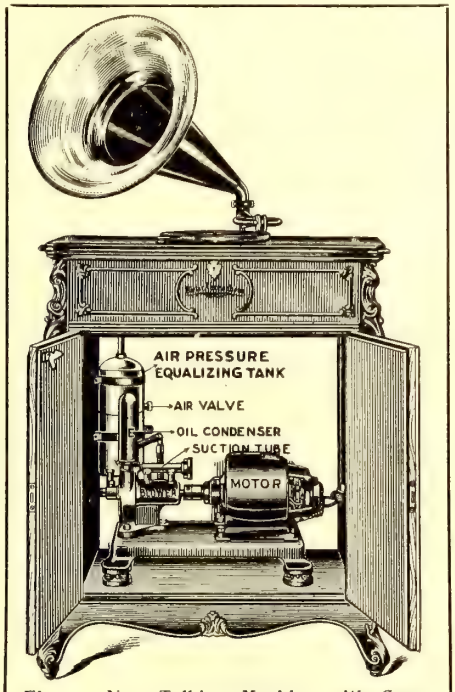


Fig. 1. New Talking Machine with Compressed Air Amplifier.

style operated by a spring motor; but of course it is readily fitted with an electric motor drive.

The second illustration shows the latest model Victrola, equipped with electric motor drive. This machine has no connection with the one aforementioned, known as the Auxetophone. A very neat and readily accessible method of mounting the electric motor drive for the standard Victrola is observed from the sketch, Fig. 2. The top table-board, containing the record holder or turntable, etc., swings on pivots, as observed, so that the motor and its speed governor, etc., become at once accessible for repairs, oiling and other attention by simply pushing a button.

NEW TELEPHONE SET FOR AVIATORS.

Our two illustrations herewith show a new style telephone set, known as the "Aero-Phone," and particularly designed and intended for the use of aviators. Its express purpose is to permit the aviator and his mechanician or passenger to talk to each other freely without being in any way interfered with, due to the excessive noise of the engine, etc.



The Aero-Phone in Use.

These aero-phone sets utilize a regular head-band, specially made and carrying two compact type watch case receivers, as observed. These receivers are held against are ears by the spring head band, so that practically all of the extraneous disturbing noises are thoroughly excluded. The spring tension, however, is so arranged that the entire outfit is not in any way uncomfortable for the wearer of the phone. Special microphone transmitters are provided with soft rubber caps on each, strapped to the chest at a point below the collar bone and above the third rib.

In speaking the chest muscles transmit the voice vibrations to the transmitter, thus enabling telephone conversation to be carried on comfortably between the two occupants of the aeroplane. The microphone is thus not placed before the mouth.

The telephone receivers and transmitters are connected by flexible cords, which terminate in a small plug. When the aviator or passenger takes a seat the plug is inserted in a jack mounted on the framework of the aeroplane. The only battery current required is that furnished by three regular dry cells, which will provide continuous service for 100 hours without any appreciable loss of transmission quality.



Aviator with Aero-Phone, Talking Through His Chest.

This perfected telephone set for aeroplane use is of great interest, particularly for military aeronautical applications.

BRONX RADIO CLUB.

The club is composed of 11 enthusiastic members, most of whom have stations of their own. Those wishing to further their knowledge of the subject are instructed by the more advanced members.

Officers are as follows: M. Haber, president; H. Berlin, vice-president; L. Brodie, secretary; A. Richter, treasurer; J. Smith, business manager.

Communications from other clubs and individuals should be addressed to L. Brodie, secretary, 1382 Boston Road, Bronx, New York.

Electricity and the Modern Automobile Torpedo

By Samuel Cohen

AMONG the most ingenious weapons of modern warfare is the automobile torpedo, a cigar-shaped shell constructed entirely of steel, with an electro-mechanical brain and carrying a high-explosive guncotton charge.

This self-propelling demon is shown at Fig. 1 with its clever devices for steering and diving. It measures 22 feet long and 21 inches in diameter, with a weight of one ton. This modern fighting machine consists of three parts, viz, a War Head, carrying 250 pounds of high explosive; the central Flask, charged with compressed air at 2,250 pounds per square inch, and an after-body or Tail, in which the propelling and controlling mechanisms are enclosed.

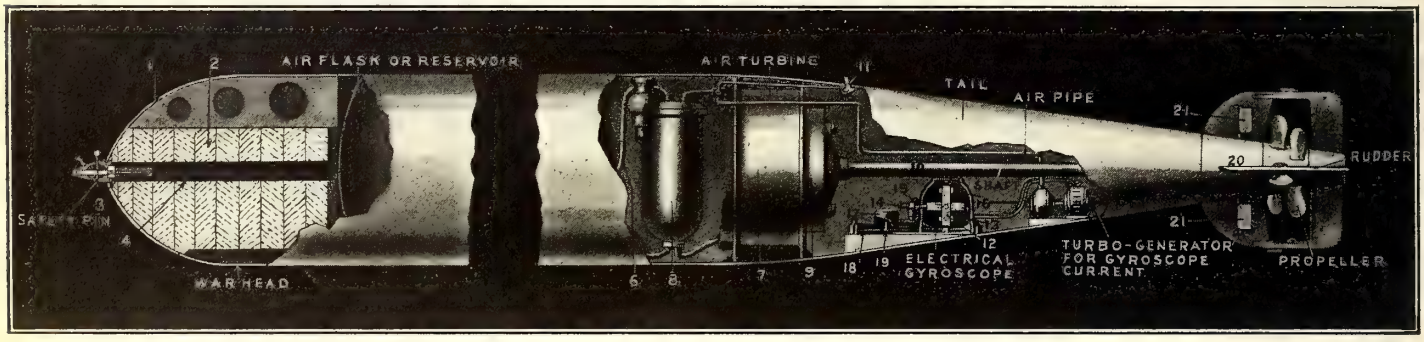


Fig. 1. Semi-Sectional View of Latest Type Automobile Torpedo. (C) Experimenter Pub. Co.

The "war-head" (1), Fig. 1, differs from the "practice-head" and is used only in actual fighting. It is loaded with a charge of guncotton (2) containing 25 per cent. moisture. At 4 is the detonating charge, which is fired by the plunger or striking rod 3. A safety pin is provided at the end of the plunger, as depicted, this being used for safety when loading the torpedo in the firing tube.

The central flask or air reservoir 6 (Fig. 1) is connected to the turbine through the superheater 8. This turbine is connected to a reducer gear 9 and then to the propeller shaft 10 which operates the two propellers 22, 22. These are rotated in opposite directions. The power developed by the turbine is 110 horsepower and the shaft runs at 1,200 R.P.M., enabling the missile to travel at the rate of 35 to 40 knots, with an extreme range of 10,000 yards.

It is in the "Tail" that the *brain* of the weapon is installed, and the little electric gyroscope 16, which a few years ago was considered a toy, steers the torpedo to the right or to the left. It is an almost human pilot and steersman, so to speak. The gyroscope herewith shown, is entirely driven by electricity, supplied by a small turbo-dynamo set. The turbine itself is operated by compressed air from the air flasks 6. This electrically operated gyroscope consists of an alternating current induction motor, with its rotor and stator 12, while 13 is a gimbal ring. The gyroscope wheel acts upon a small crank lever 15, which is connected to the control lever 16, operating the vertical rudders 21.

As is well known, a gyroscope will always attempt to maintain its center of gravity with respect to a certain point or angle. That is to say, if we have a wheel of any type revolving at very high speed in a certain position, with respect to its axis of rotation, then any effort to change the plane of this wheel, in so far as its rotation is concerned, will be found to cause considerable effort necessary in order to accomplish this change. Thus, the gyroscopic principle is brought into play in order to keep the modern automobile torpedo in a true course. As becomes evident, and especially when the water is very rough, it is practically impossible to discharge one of these high-speed torpedoes with a "fixed rudder" or steering gear on same, which shall cause this weapon to absolutely maintain its natural course along a straight line, as was previously intended when discharging same.

Therefore when the torpedo shell is deflected from its course, even to a slight degree, by tidal or wave currents, etc, it will be maintained in practically a *dead straight course* by the correcting action of the electrically driven gyroscope.

The rapidly revolving gyroscope element 12 will, as seen from the foregoing description, tend to rotate from in the same axial plane as at the moment previous to the deviation of the torpedo's true course. Hence the gyroscope will swing about, so as to maintain its *original* plane of rotation, even though the hull of the torpedo may be pointing several degrees off its true course at the moment due to interfering water currents, etc.

When the rotating gyroscope element 12 makes this swing about its plane it will carry the gimbal ring 13 with it. On this ring is a trigger release cam which, as the ring 13 moves around, allows the spring-actuated cam rod 14 to slide forward.

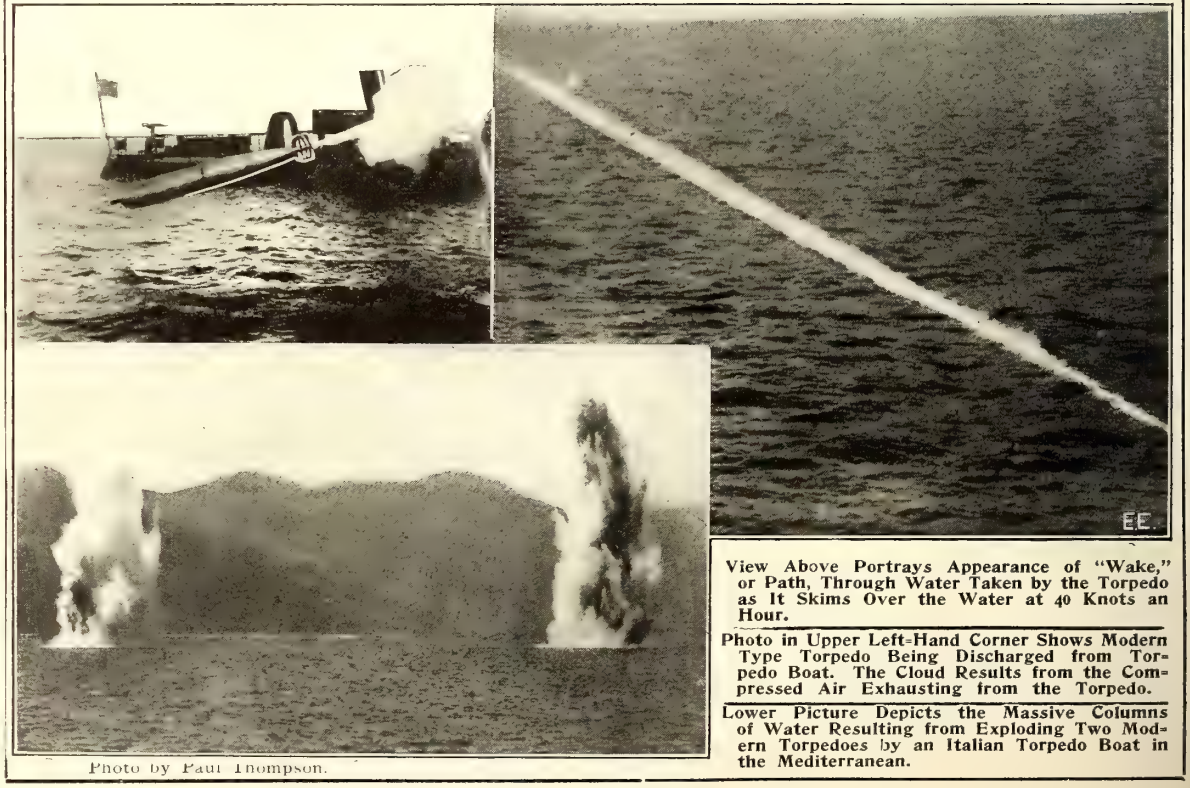


Photo by Paul Thompson.

View Above Portrays Appearance of "Wake," or Path, Through Water Taken by the Torpedo as It Skims Over the Water at 40 Knots an Hour.

Photo in Upper Left-Hand Corner Shows Modern Type Torpedo Being Discharged from Torpedo Boat. The Cloud Results from the Compressed Air Exhausting from the Torpedo.

Lower Picture Depicts the Massive Columns of Water Resulting from Exploding Two Modern Torpedoes by an Italian Torpedo Boat in the Mediterranean.

When this cam rod slides forward, as described, it ejects or pushes upward the rudder control trigger 15. When the torpedo has been thus automatically brought back into its true course it will be seen that the gyroscope will then have its gimbal ring 13 brought back into its normal plane, and in so doing it will, of course, reset the cam rod 14 to its normal position, and so on.

The depth of the torpedo is regulated by a depth-control mechanism 17. It consists of a metallic diaphragm 18, actuating lever 19 and in turn operating the rudders 20. This device is usually "set" for 15 feet below the surface of the water, so that when the tube is fired it will go below this mark, but the diaphragm immediately is actuated by the greater pressure of the water and in turn lowers the rudders 20, which raises the torpedo to its proper level.

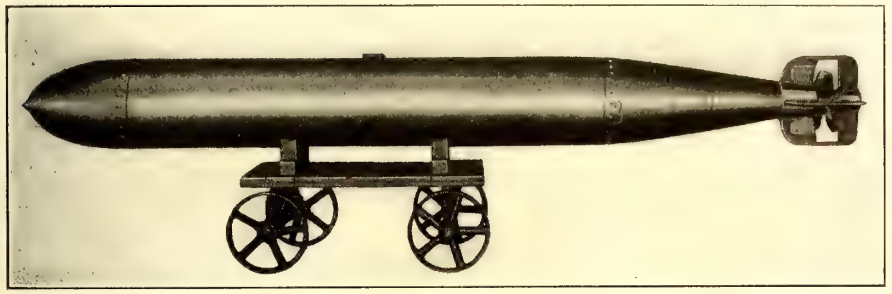


Fig. 2. Actual Photograph of Bliss-Leavitt Automobile Torpedo.

A new method of controlling the depth of torpedo tubes has been recently tried which employs electricity. This is kept secret at present and information on the details of this system is unavailable now

The torpedoes are launched from a discharging tube by an impulse charge of compressed air. As soon as the torpedo is launched the trigger 11, at the center of the flask, is released, which disengages the high pressure valve of the reservoir and the turbine, and in turn operates the two propellers. As soon as the torpedo strikes the water it submerges to the proper depth and rushes with a mad pace straight to its target.

One of the latest 21-inch diameter automobile torpedoes of the Bliss-Leavitt type is shown in Fig. 2. This complicated machine costs nearly $6,000 to build. Uncle Sam is now expending large sums of money in building these weapons, and the Newport naval factory is turning out about 100 of them annually. These fighting sea machines have proven a great success, as shown in the present European conflict.

NEW FLY CHASING CEILING FAN.

The photograph portrays a new fly-chasing electric ceiling fan recently installed in the Reading Terminal Market, Philadelphia, Pa., and at present there are 42 of them in operation. The fans are a special type made up for the purpose, running at 100 revolutions per minute and with a very slight pitched blade so there is practically no breeze developed by them. The blades have a sweep of 90 inches. The purpose of the fan is simply to throw a moving shadow on the meats, fruits and vegetables to scare the flies away.

These fans have the advantage over an ordinary ceiling fan with a high speed, in that the ordinary fan causes meats to become black and also hastens the decay of fruits and vegetables, while this new design gives very little breeze and does not affect them. Flies are also in evidence where the ordinary fan is used, but the shadow effect scares the flies and has completely solved the problem for market-house people.

Thus a little science added to practise has apparently solved a very troublesome problem.



The Shadow, Not the Breeze, Chases the Flies.

TENNESSEE TRI-STATE FAIR TO HAVE RADIO.

Visitors to the Tri-State fair at Memphis, Tenn., who want to send their regards to the Kaiser or Kitchener, can step into a wireless office, write out the message, pay a fee of a few dollars a word, and let 'er zip.

This became known recently when Frank Fuller, secretary of the fair association, stated that the Tri-State Wireless Association was going to install a service branch at the fair grounds.

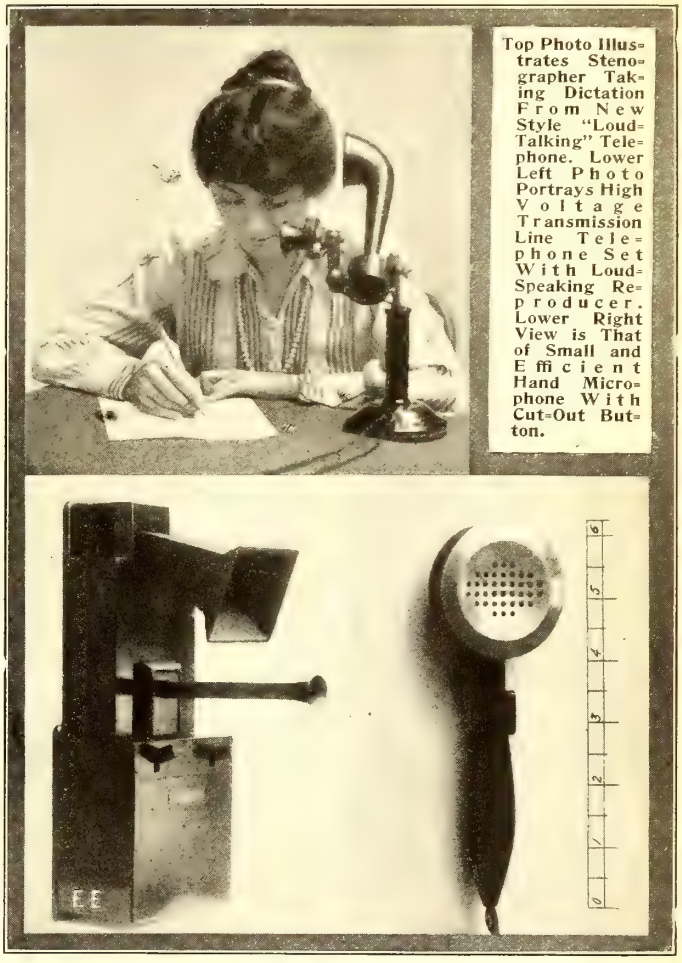
An aerial will be erected and apparatus with sufficient power to give the visitors an idea of what a real wireless station is, will be installed.

MODERN APPLICATIONS OF THE LOUD SPEAKING TELEPHONE.

The "loud talker," or more properly the loud-speaking telephone, is now being extensively employed in places where the ordinary telephone cannot be used, and the illustrations herewith presented depict some novel applications. Fig. 1 portrays a stenographer taking dictation from her employer by means of these loud talkers. The transmitter is placed on the left of the apparatus, as seen, and is utilized in ordinary talking, as for instance, when the stenographer desires repetition of a sentence, etc.

This method of dictating is very efficacious as a time saver, and eliminates the use of a buzzer or bell in calling the stenographer.

Fig. 2 illustrates a field-type loud talker employed in high-tension line work, where the linemen need to keep in constant touch with the switchboard operator at the power station. This instrument is constructed entirely of an insulating material, so that the high voltage of the line does not enter the instrument in proximity to the person talking. The square-shaped horn leads to the receiver, and the long, round tube in the center is connected to the microphone transmitter. The small handles in front are the two switches operating the calling and talking circuits.



Top Photo Illustrates Stenographer Taking Dictation From New Style "Loud-Talking" Telephone. Lower Left Photo Portrays High Voltage Transmission Line Telephone Set With Loud-Speaking Reproducer. Lower Right View is That of Small and Efficient Hand Microphone With Cut-Out Button.

A miniature hand-style transmitter for general use is shown in Fig. 3. It is of the ordinary carbon-grain type and it measures 6¼ inches long by 2¼ inches and weighs only four ounces. This transmitter can be placed in the regular telephone circuit. A small push-button is placed near the end, as depicted, and is used for calling purposes. These instruments have been developed by the Stentor Electric Co.

Sayville Once More

An Attack on the Electrical Experimenter

THE two letters reproduced herewith require no comment. The one illustrates the German viewpoint, the other the American. We leave it to our readers to decide which is the correct one.

Dr. K. G. Frank, as is well known, is the present executive head of the Sayville wireless station. On August 17 the *Providence Journal* laid before the U. S. Neutrality Board in Washington eight formal charges. One of these charges was that Dr. K. G. Frank is the head in the United States of what is known in Berlin as an Information Bureau (secret service).

The letters follow:

ATLANTIC COMMUNICATION CO.
(Telefunken System of Wireless Telegraphy)
47-49 West Street,

The Experimenter Publishing Co.,
Attention Mr. H. Gernback, Editor.

Dear Sir:—With regret and surprise I have read your editorial in No. 28 of *The Electrical Experimenter* on "Sayville."

According to my knowledge your paper is the only technical paper which joins some of the daily newspapers in the contemptible attempt to cast suspicion upon Sayville. One would at least expect that your paper would take cognizance of the fact that not only no single instance of an unneutral act can be proved, but also that there has never been any charge of such act made by any official of the United States Government.

The standard of the technical and scientific press in this country is, fortunately, so high that I am convinced your paper will remain the only one which distinguishes itself in such manner.

Very truly yours,
(Signed) *Dr. K. G. Frank.*
New York, N. Y., August 17, 1915.

Atlantic Communication Co.,
New York City.
Attention Dr. K. G. Frank.

Dear Sir:—

The writer was indeed surprised to receive your communication of August 17. He is at a loss to understand how you could possibly misconstrue the true meaning of his editorial in view of the fact that at the time it was published Sayville had already been taken over by the Government. What the editorial meant to convey was that even though the Government had taken over Sayville, it was not at all certain that messages pregnant with unneutral information, yet harmless on their face, could not be sent in spite of all censorship. The imaginary case of the message from the "Adriatic" was cited as an illustration. Anyone by paying the usual tolls can even now send such a message. The management or the operators at the Sayville station obviously need not necessarily have cognizance that the message is an unneutral one.

That the writer's viewpoint was correct is best shown by the announcement of Secretary of the Navy Daniels under date of August 18, "that as a result of the demonstration that unneutral messages could be sent through the Sayville station he had issued orders that in all cases where the Government experts were in doubt about any message presented for sending it should be referred to Washington for judgment."

As to the second paragraph in your letter your attention is directed to page 210, September issue of *The Electrical Experimenter*. It gives facts with which you are doubtless familiar. These facts disclose one of the main reasons why Sayville was taken over by our Government.

Your assertion that "*The Electrical Experimenter* is joining some of the daily newspapers in the contemptible attempt to cast suspicion upon Sayville and, further, that no single instance of a dishonorable act can be proved, but also that there has never been any charge of such act made by any official of the United States Government," is as perverted as it is unfounded. Its tone is also resented by the writer. *The Electrical Experimenter* certainly never attempted to cast suspicion upon Sayville, but it has shown that the station can, and perhaps has been used to convey unneutral messages, though not necessarily with the knowledge of the management or its operators.

At the same time the writer desires to voice his opinion that there is sufficient circumstantial evidence at hand to lead anyone who wishes to view the matter in its true light to believe that the management of the Sayville station probably had some knowledge of the real purport of the many "irregular" messages sent over the Atlantic by Sayville before the station was finally taken over by the United States Government.

The slur contained in your last paragraph is best met by bringing to your attention the fact that *The Electrical Experimenter* to-day is considered an authority on wireless matters in this country. As such it is its duty to publish any matter of interest to the wireless world. It will distinguish itself in the future by continuing to do so. It will also continue voicing its opinion especially at times when the welfare of this country is concerned.

Very truly yours,
The Experimenter Publishing Co.
(Signed) H. GERNSBACK, *Editor.*
New York, August 30, 1915.

$2,500.00 Edison Day Contest for Boys and Girls

Edison, the Wizard of Menlo Park, whose name is mentioned with reverence by all for his inventive ability, has always been liked by his fellow investigators. It was his invention of the incandescent lamp 36 years ago that will indirectly cause him to be equally liked by thousands of boys and girls throughout the country.

From the crude little carbon filament lamp that made its initial bow to the world on October 21, 1879, it has rapidly advanced to the modern high efficiency tungsten filament lamp of to-day known universally as the *Mazda*.

The manufacturers of the modern form of this lamp are planning a unique advertising campaign that will enable numerous children to win, in all, $2,500.00 worth of valuable prizes.

These lamps are so saving of current and give such satisfying results that not to use them is a loss of money to the storekeepers and the householder; therefore, to introduce this lamp more widely this special campaign was organized. It is understood, of course, that you must live in a town having electric lights, but if you live sufficiently near a city you may enter the contest.

The plan outlined is as follows: You obtain cards from the local agent for Edison Mazda lamps and after signing your name in the proper space thereon you distribute them to persons whom you think can be induced to use the lamps. You get as many cards as you think you can distribute, then go in to "win." Make a list of people and visit them. Learn all you can about the prices and different sizes of lamps, so as to be able to talk intelligently on the subject.

Instruct the people you visit that they are to hand in your card with their order for lamps, so you can see it is necessary to get into action before another boy or girl can get in ahead of you. Don't distribute your cards before the 21st of September, although you can obtain the cards before that date.

Any further details are explained by the Conditions:

1. You must be under 18 years of age.
2. You must live in or near a town having electric light.
3. You must get a number of cards from the local lighting company or agent for Edison Mazda lamps.
4. You must sign your name and address to all the cards.
5. You must distribute the cards to users of electric light in homes, stores, factories, etc., from September 21 to October 21, 1915.
6. The cards will be returned to the lighting company or Edison agents as orders for Edison Mazda lamps at any time between September 21 and October 21, 1915.
7. A *watt* is a point. For example: A card with your name on is turned in as an order for four 40-watt Edison Mazda lamps. This credits you with (4x40) 160 points.
8. After October 21 the lighting company or Edison agent turns in all the cards to the Edison Lamp Works of the General Electric Company, Harrison, N. J.
9. The cards are sorted and the boy or girl whose name appears on cards totaling the greatest number of watts or points gets first prize, the next largest the second prize and so on down.
10. In case of a tie by two or more contestants, each one will receive the prize.
11. The prizes will be distributed by the Edison Lamp Works of the General Electric Company as soon as the cards are counted and the winners determined.
12. No prize will be awarded to any employe of the General Electric Company, lamp agent or lighting company.

You have the plan before you, now mobilize your forces, bring up your artillery, for there's an *Indian motorcycle* for first prize for the boys, and an Edison diamond disc *Phonograph* as first prize for the girls. The other prizes for boys run all the way from a row-boat motor to baseballs and gloves, including canoes, watches, boxing gloves, rifles; and girls' prizes include mandolins, wrist watches, electric chafing dish, toasters, desk sets, fountain pens. A host of valuable articles, all told, and 2,000 flash-lights are to be given away.

It will require some work, but you will enjoy it as much as the premium you will win.

THE CONSTRUCTOR



Construction of an Inductive Tuner.

By Milton B. Sleeper

IN the design of this tuner are incorporated all the advantages of the larger, more awkward designs, in a compact enclosed form, having a *centralized control* for the sharpest tuning by simple adjustments. With the regulation size antenna it will bring in signals over 1,200 meters; the largest range any tuner can have without being affected by dead-end losses. Fig. 1 shows the unique tuning control. On the large 30-point switch every fourth turn of the primary is tapped, while with the compensator handle, in the middle of the other, three turns can be added, one at a time. This gives the sharpest tuning possible in the simplest way. Taps from the secondary, 10 in number, are brought to the right hand switch. The coupling, while sliding, is adjusted by rotating the handle 65 degrees, giving to this type the advantage of the variometer. Although it has ample variation of coupling, it is a very compact instrument. To keep the coils from being affected by the atmosphere, and to protect the working parts from dust it is enclosed, except for the controls. These are closely grouped on the front of the case. Tuning can be done many times quicker, with less effort than is required with the ordinary type, where the primary switch or slider is at one end, the secondary switch at the other, while a movement of 5 or 6 inches is required to vary the coupling.

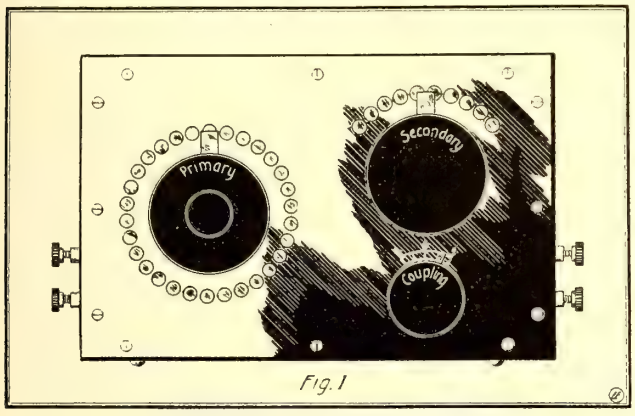


Fig. 1. Front View of Completed Coupler.

At the conclusion of the article is an entire list of parts, with their size, number, material, etc. Using this list, all the rough materials should be bought before any actual work is done. Then do not put any pieces together until they are *all completed*. Follow the drawings closely, otherwise the pieces will not fit.

Coils.

Cores.—These are shown sectionally in Fig. 2. While ordinary mailing tubes can be used for the cores by changing the diameter of the inside pieces, it is not at all advisable; the drawings are for tubes made by Beetle & Maclean. As they are not made just the right size, they must be purchased oversized. Get one 7½x3 9/16x4 inches and one 7½x3¼x3½ inches. First cut them 3¼ inches long with a hacksaw, then finish the tubes to the proper length with sandpaper on a large block. As the larger coil is too small inside, it must be worked out with sand paper or a coarse file to the required diameter. Keep the walls uniform in thickness. One-sixteenth of an inch must be taken from the outside diameter of the smaller core. This is to allow room enough for them to slide. After the cores are brought to size, rub them smooth with fine sand paper. Do not shellac or in any way moisten or heat the tubes, as this causes them to expand. After two or three weeks they shrink again, and if the coils are wound the wire loosens. One-half pound of No. 24 double silk-covered wire is required for the primary.

Primary winding.—Begin at the left-hand end to wind. To start the winding, make two small holes one-sixteenth of an inch from the end of the tube. Put the end of the wire from the outside into one hole and bring it out the other, leaving the loose end 6 inches long for connection. It is best to run the wire over a series of spools on spikes pounded into a flat board. This keeps the wire tight without rubbing the insulation. Hold the coil in your lap, facing away from the spool of wire. Turn the coil with one hand and guide the wire with the other. Do not turn the wire around the core, as this makes kinks.

The taps are made in the following order: beginning of winding, end of first turn, end of second turn, end of third, 7, 9, 12, 16, 20, 24, 28, 32, 36, 40, 44, 48, 52, 56, 60, 64, 68, 72, 76, 80, 84, 88, 92, 96, 100, 104, 108, 112, 116, 120. (1) Fig. 6 shows the method of making taps. The taps should be made in a straight line down the coil; however, the first ones should be staggered a little, so the bare wires will not come in contact with each other. Be careful in scraping the insulation where the taps are twisted (see Fig. 6) not to cut the wire. By scraping the wire in this way losses from taps are minimized. Leave a good 6 inches for connections to the switch. It is well to run a little sealing wax over the wire where the taps are made. When the winding is complete fasten the end through two holes as before, leaving enough for connection. Next, cut up four strips of thin cloth, 4 inches by ½ inch, and soak them in fairly thick shellac. Then lay them lengthwise on the winding, 90 degrees apart. Cut off the ends of the cloth even with the ends of the tube; do not turn them under. This will keep the wire tight without shellacking it all over. Inside the core at the bottom, 90 degrees from the line of taps, glue the two guides 1/16 of an inch apart (Figs. 2 and 3, which will keep the secondary

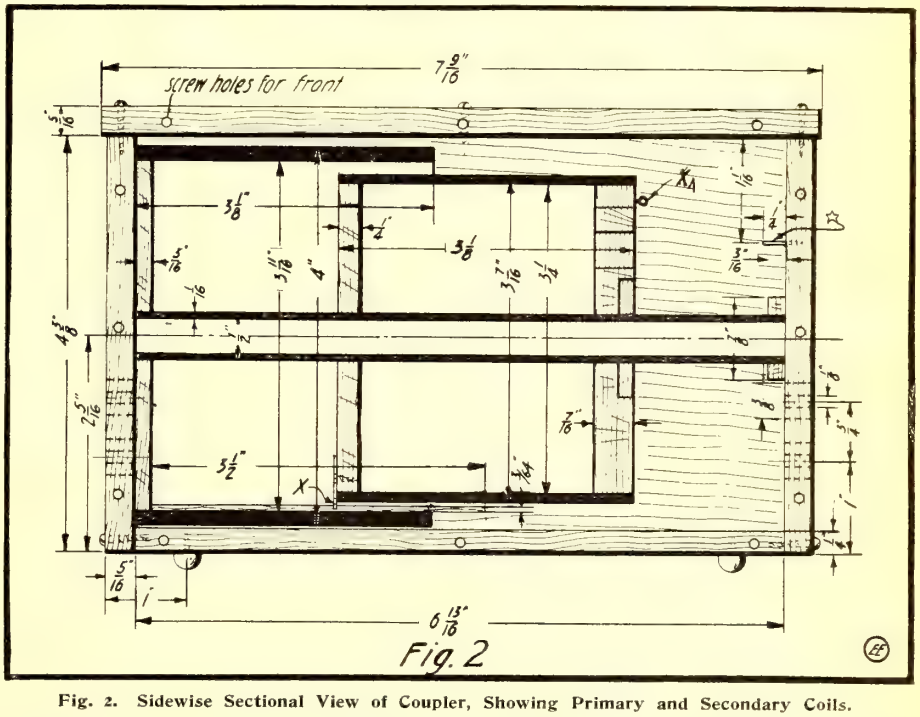


Fig. 2. Sidewise Sectional View of Coupler, Showing Primary and Secondary Coils.

from turning. Be careful they are *perfectly* parallel with the axis of the core.

Secondary.—One-fourth pound of No. 26 double silk-covered wire is required for the secondary coil. The taps (see (2) Fig. 6) are made differently. Instead of coming from the outside, they must come from the inside of the core. Beginning 1/16 of an inch from the end of the secondary core, mark off 3/10 of an inch 10 times. At these points make holes just large enough to slip the wire. There are 14 turns of wire between these holes. If the holes are made right and the wire is tightly wound this will be just the right distance. These taps must be at least 10 inches long. Put thin strips of cloth with shellac on this winding also.

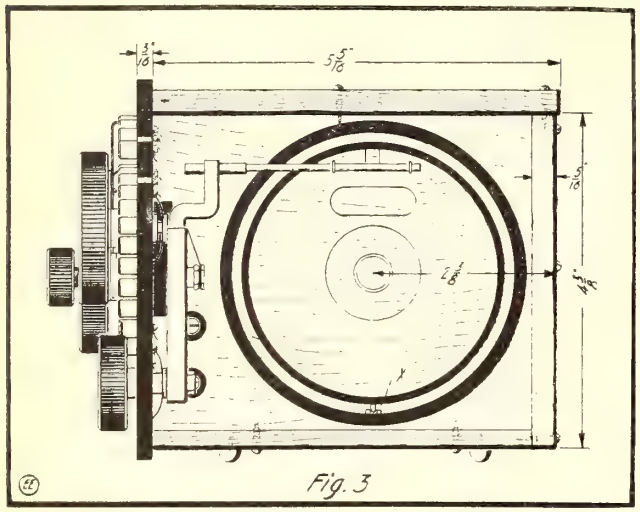


Fig. 3. Assembly of Primary and Secondary Coils in Cabinet.

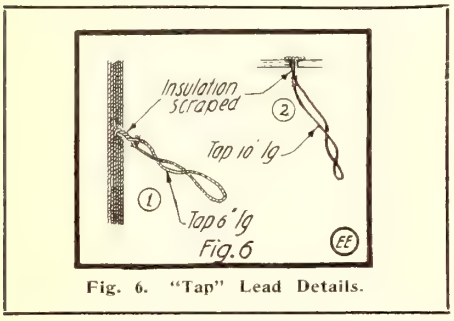


Fig. 6. "Tap" Lead Details.

Cabinet Details.

The dimensions for the case are given in Figs. 2 and 3 and in the list of parts. Each piece must be perfectly accurate or the case will not look well nor will the other parts fit in it properly. Put the bushings in from the *outside;* then it will not matter if the wood is chipped in forcing the bushings into the holes. The staple X in Fig. 2 is 1¼ inches long. Drive it into the end-piece before the case is assembled. An excellent finish can be made with a dark mahogany stain. When it is perfectly dry apply three coats of thin white shellac and rub it down with finest sandpaper covered with linseed oil. This gives a dull, durable polish. The rubber feet on the bottom prevent the case from scratching the table and keep the case up to allow for the overhang of the front.

Primary Switch.

The parts of this switch must be turned out exactly. Fig. 4 gives the details. (1) shows the underside of the handle; (2) is a section through the switch; (3) is the back side of the switch, showing the compensator. The large switch contact is made of three thicknesses of No. 30 spring brass. This gives a better contact than can be had with a single piece. It is fastened to the plate by a screw threaded into the handle. The plate is held to the center piece (D) by a little drop of solder. Connection is made by soldering a strip of copper to the spring (A) under the centerpiece. In this way connection is made to the switch-points through the switch contact, plate, centerpiece and spring. The handle must fit tightly over the end of (D) to keep it from slipping. The insulating tube (C) is forced into (D), but the compensator rod (B) must turn easily in the tube. The four switch-points for the compensator are made of round-head 8-32 screws, their heads turned down 3/16 inch in diameter and 1/16 inch thick, then lugs for the taps are fastened under the heads of the screws. To keep the compensator switch contact from turning off the points it is necessary to put in a stopping pin at each side. The spring (A) must be strong to hold the switch together. The nuts which hold the compensator contact must not be screwed too far down or the compensator handle will bind. Get all the switches fastened to the front and in working order before fastening any taps.

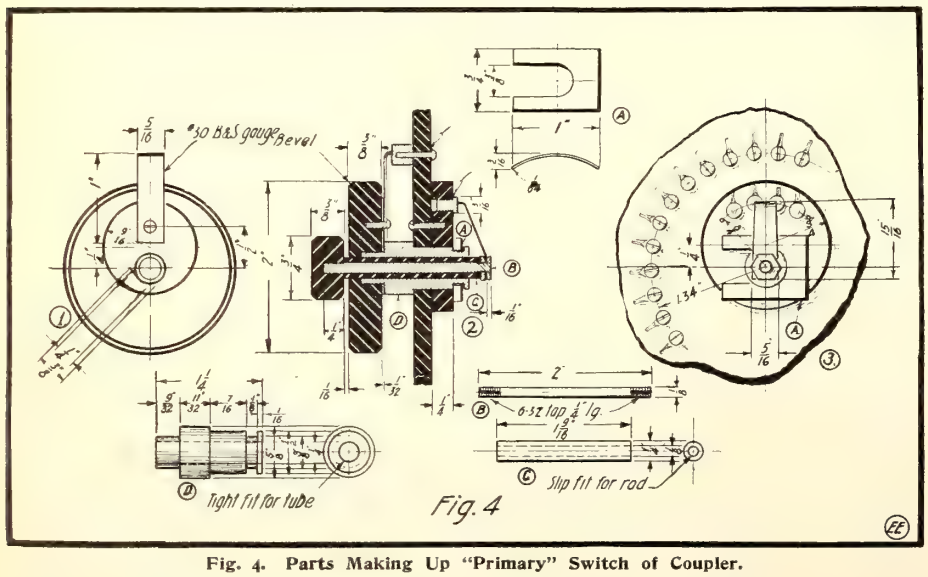


Fig. 4. Parts Making Up "Primary" Switch of Coupler.

Secondary Switch.

Fig. 5 gives the dimensions of this switch. This contact is also made with three thicknesses of brass strip. The connection is made by a copper strip soldered to the spring on the back side. Although it is not necessary, it is best to knurl and bevel the edges of the handles as Fig. 3 shows.

(*To be concluded.*)

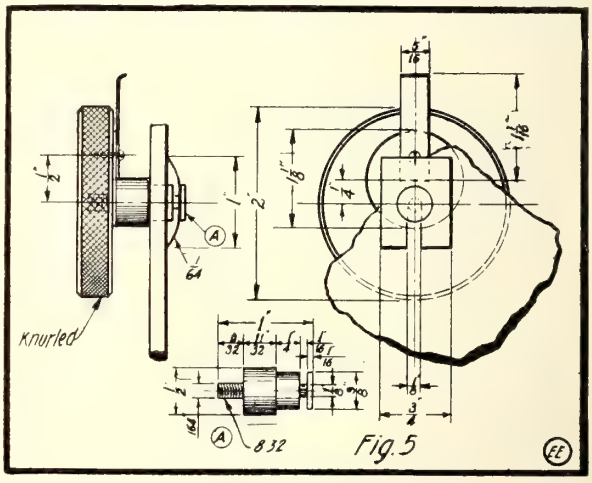


Fig. 5. Details of Secondary Switch.

TREATMENT FOR SULPHATED STORAGE BATTERY PLATES.

A great many experimenters have storage battery plates on their hands from time to time which have become badly sulphated as indicated by a tenacious white coating, which gathers on the surface of the plates. Of course this renders them practically inactive so far as the regular function of the storage battery is concerned.

A method not generally known is described below for the treatment of such sulphated plates, but great care should be exercised in using this method in the thorough washing of the plates after the bath below mentioned has been utilized.

Before replacing the plates in the battery they should be washed 12 to 15 times in different changes of water or placed for a considerable period under a running water spigot, or otherwise any remaining ammonium acetate in the plates would cause them to disintegrate when the battery was again put in service.

This special sulphation treatment "bath" is made up of about one-half pound of ammonium acetate, dissolved in one quart of water and put in an earthenware jar. The lead storage battery plates requiring treatment are immersed in this solution for about one-half hour, and they should be kept hot during this period by a gentle flame placed under the jar. The plates will now become freed from the sulphate coating, and they are then afterward removed from the jar and very thoroughly washed as previously explained. The ammonium acetate can be purchased at any drug store or chemists' supply house and is fairly cheap. A larger bath solution may be made up, of course, following the above proportions.

HOW TO CLEAN BRASS.

Brass instruments or parts thereof that have become tarnished from exposure to air may be cleaned in the following manner: Boil for a few minutes in a solution of one ounce of alum to every part of water. Then polish with any kind of brass polish, or even a dry cloth will do. This will remove tarnish from all crevices where other means have failed. S. C. V.

ELECTRIC IGNITION SCHEME FOR GAS RANGES.

The electrical experimenter may put some of his ideas to a good purpose in rigging up an electric ignition system on the kitchen gas range. Two methods are suggested in the drawings herewith, at Figs. 1, 2 and 3.

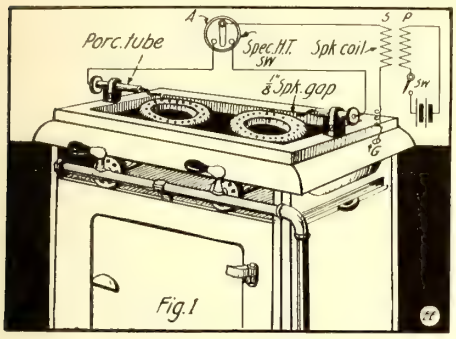


Fig. 1. "Jump" Spark Applied to Gas Range.

At Fig. 1 is indicated the connections for utilizing a small jump spark coil of about ½-inch rating, together with battery and primary switch, and also the specially insulated secondary switch. The secondary wiring for the jump spark circuit to the burners should be made with high tension or automobile engine cable. Ordinary wire may be used, as sketch shows, by leading this wire through porcelain tubes suitably secured to the top of the stove. Two or more burners may be provided with spark circuits by using two or more switch points on the high-tension switch A. This switch should have good spacing between the points and the blade on same should be about 4 inches long. It should be provided with a hard rubber stem and handle, so that the hand will be several inches away when manipulating same.

As evidenced from diagram, Fig. 1, both the primary and secondary switches have to be manipulated when the gas is turned on in the burner. The spark jumps from the wire (at the end of the porcelain tube), which is placed over one of the small holes in the burner, to the burner itself. One side of the secondary winding of the coil is grounded, at G, to the stove frame.

It is very easy to rig up an automatic primary switching stunt for this outfit using a jump spark coil, as shown at Fig. 3 in detail. The one primary wire is joined to the iron frame of the stove and the other primary wire connects to an insulated copper or brass wipe spring, as observed. A metal pin, such as a machine screw, tapped into the knob of the gas valve handle makes contact through the first part of its swing with the wipe spring. Thus the primary circuit is closed while the gas valve is being first turned open and the secondary spark from the coil jumps at the burner, igniting the gas. As the valve handle is opened further it breaks contact with the wipe spring and the spark is cut off. The secondary H. T. switch still has to be used for the different burners.

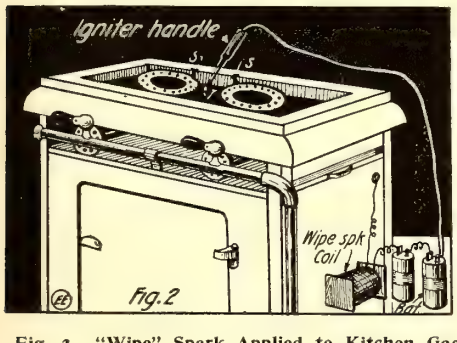


Fig. 2. "Wipe" Spark Applied to Kitchen Gas Range.

At Fig. 2 is shown a common system used in shops and readily adaptable, of course, to the kitchen gas range, whereby a common "inductance" or "kick" coil is utilized in series with a battery. The spark produced in this way is a "wipe" spark, as it is commonly termed. To create the spark a metal-tipped handle T is used to make and break the circuit against a sparking wire or point over one of the holes in the gas burner, as at S S. This wire S may be a piece of steel or German silver stock.

In operation the gas is turned on and directly after it, the igniter handle T is passed across the spark point S, thereby producing a "wipe" spark, which ignites the gas. A battery of four dry cells is usually sufficient and ordinary bell wire may be used in hooking up the circuits between the battery, stove and coil.

Inductance spark coils may be purchased cheaply at any electrical supply store and are commonly known as "gas lighting coils." It also may be made up from an iron wire core about 9 inches long by 1 inch in diameter. This core is provided with two wooden discs at the ends about 2½ inches in diameter and the core is covered with several layers of heavy paper. Over this is wound 8 to 10 layers of No. 14 cotton-covered or enameled copper magnet wire. This coil will serve for all kinds of gas ignition, utilizing the "wipe" spark principle. Contributed by

JOHN GALLAGHER.

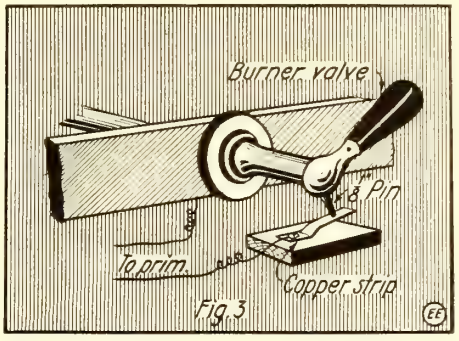


Fig. 3. Detail of Automatic Gas Stove Igniter Attachment.

ELECTRIC LIGHT FROM HIGH TENSION MAGNETOS.

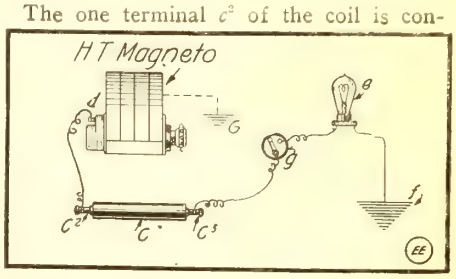
With the advent of magnetos for the purposes of ignition in internal combustion engines, the thoughts of motorcycle and automobile manufactures turned to the possibility of introducing in a satisfactory manner, some means whereby the electric current generated by the magneto, could be utilized for illumination, as well as for ignition.

Accordingly, various devices to effect this happy combination have been given birth, and one of them because of its simplicity of construction and operation, is worthy of consideration.

The device is of recent invention and is the subject of an English patent. The principle the inventors have worked upon is that of transforming the voltage at the primary terminals of the magneto down to that of the lamp to be used. The invention accordingly consists of a resistance in the form of an iron core choking coil, *c* together with an incandescent electric lamp *e* (preferably of the metallic filament type) connected between the primary winding *d* of the magneto and the particular means employed to earth one end of this winding, say at *f*.

A convenient arrangement is shown in the accompanying drawing illustrating a diagrammatic view of the complete apparatus, including a *Bosch* high-tension magneto.

The one terminal c^2 of the coil is connected to the terminal *d*, which is in connection with the primary winding of the magneto, and is provided for use in conjunction with a switch *g*, whereby the ignition may be cut out by earthing the primary current and preventing an effective portion of it passing through the contact breaker. The other terminal c^3 is connected to one of the terminals of the lamp; the other terminal of which is "earthed" at *f*. A switch *g* may be inserted in the circuit at any convenient place between the coil *c* and earth, whereby the lamp may be put into and out of action.



Electric Light From High Tension Magnetos.

The inventors have subjected this device to a test with a one and two-cylinder motor-cycle engine, employing a *Bosch* magneto for ignition purposes, using a metallic filament lamp of 3.5 volts. Their experiments have shown that excellent results can be obtained from an iron core having a length of about 4 to 5 inches and a diameter of 5/16 inches, wound with approximately 517 turns of double cotton-covered copper wire No. 24 and efficiently insulated between the windings. The apparatus may be applied to other suitable magnetos in a substantially similar manner.

A POWERFUL ELECTRO-MAGNET FOR BATTERIES.

A great many electrical experimenters often wish to have a good strong electro-magnet suitable for excitation on a few

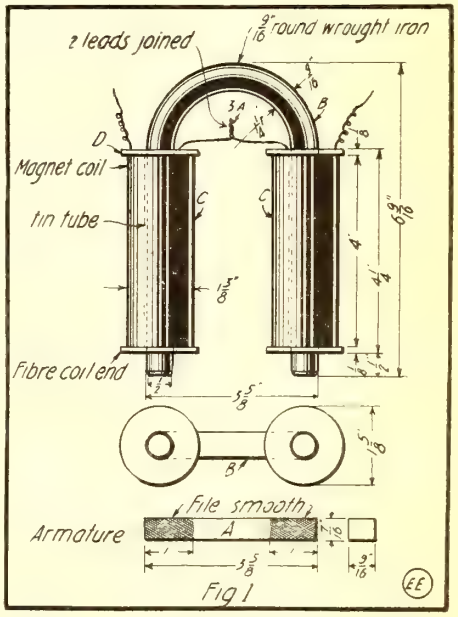


Fig. 1. Parts of Powerful Battery Magnet.

battery cells, such as dry cells, for instance. The following describes the detailed construction of such a magnet. This data is from an instrument that has actually been built and, when operated on 10 ordinary dry cells, such as the "Columbia," it developed a lifting power of 50 pounds, the voltage being 15 and the current in amperes 0.95. This lifting effort was attained by tying the load to the center of the iron armature A.

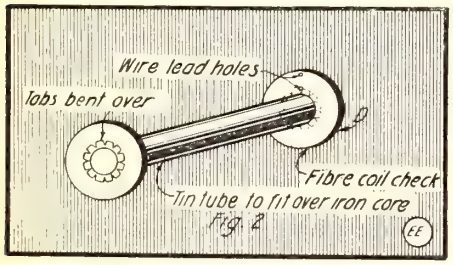


Fig. 2. Making Magnet Coil Spools.

To begin with, a piece of wrought iron bar should be obtained at the hardware store or from a blacksmith, and it should have a diameter of 9-16 inch. Its length should be sufficient to allow of bending to the dimensions shown in the sketch Fig. 1 at B. Another short piece of square wrought iron bar, A, Fig. 1, is required also to form the armature. One side of the armature bar, that which is to be in contact with the pole faces of the magnet, must be filed off smooth and flat for about 1 inch at both ends to insure a good magnetic circuit between these two parts of the iron circuit.

After the piece of 9-16 inch round iron bar has been bent to a "U" shape, as indicated in Fig. 1, the two pole contact faces must be filed up smooth and flat with respect to each other. Also to increase the magnetic density at the pole faces, and thereby gaining a greater pull, these pole face areas are reduced as shown, so that they have but ½ inch diameter. This can be accomplished very easily with a file.

The magnetizing coils are wound on two tin spools or bobbins, made after the fashion illustrated at Fig. 2. The end cheeks of these spools are made of heavy cardboard or fiber. The tin tubes should be about 4½ inches long and fit nicely over the iron core legs. After making the tubes, which can be held together by a little solder, the end cheeks are placed on them and the ends of the tubes (previously cut all way around for about ⅛ inch deep are bent upward to hold the cheeks on. One cheek on each bobbin should have two 1-16

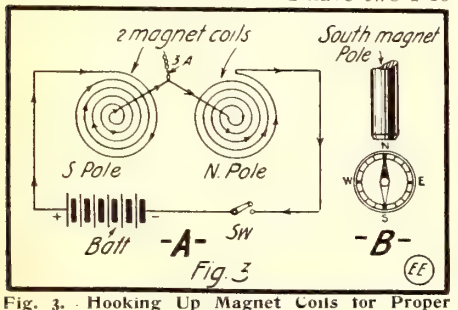


Fig. 3. Hooking Up Magnet Coils for Proper Polarity.

inch holes drilled through them—one near the tube and the other close to the outer edge. These are to lead the coil or wire terminals through.

When the two bobbins have been finished thus far they are insulated over the metal portions by wrapping two layers of ordinary notepaper around them. This paper must fit snugly up against the end cheeks to prevent the coil wires from touching the metallic part of the bobbins, as this would be liable to cause a "ground."

The bobbins are each wound with 14 layers of No. 22 B. & S. single cotton-covered copper magnet wire (this requires about 2¼ pounds of wire). These layers are to be placed on evenly, and not wound on any old way, as fewer turns are obtained on the coils in this way. The starting terminal of the coil is led through the inner hole in the end cheek, while the finishing terminal is brought out through the outer cheek hole previously made for it. The two magnet coils are joined in series at 3A in diagram. In assembling the complete electro-magnet the relative magnetic polarity of the two poles must be observed, and reference to Fig. 3 will make this quite clear.

The poles of a magnet are termed north and south, depending upon whether or not they attract the N. or S. pole of a magnetic needle, such as in the small compass shown in Fig. 3 at B. By looking at the diagram Fig. 3 A, it is perceived that the current must travel around the two magnetizing coils in opposite directions to give resultant

(*Continued on page* 302.)

HOW TO BUILD AN ELECTRIC FURNACE FOR LABORATORY USE.

Following is a description of an inexpensive, but practical, experimental electric furnace.

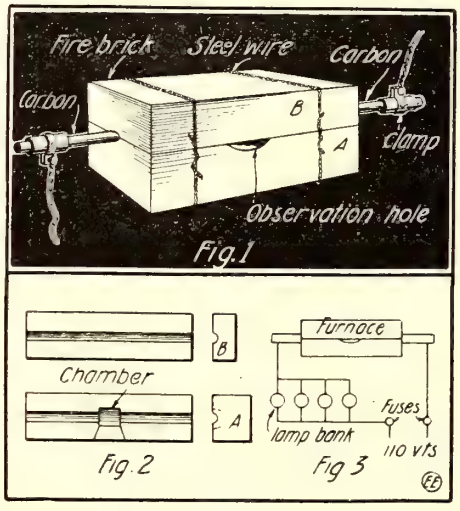
The materials necessary are two fire bricks (such as those used in building fireproof structures), two carbon rods, and two pieces of No. 10 gauge steel wire, about 25 inches long, to be used in holding the fire bricks together.

Grind or file a groove in A and B, as shown in Fig. 2, so that when the bricks are placed in position the carbon rods to be inserted will slide easily back and forth.

On one brick, used for the base of the furnace, chisel a groove in the middle, two inches in diameter, so that it forms a semicircle (see Fig. 1). This hole will be used in making observations of the reactions that take place and for the insertion and extraction of materials to be melted, which are placed in the grooved chamber between the ends of the carbon rods.

This simple furnace when properly assembled and connected to 110-volt lighting current, as illustrated in Fig. 3, will develop such an intense heat that some of the following refractory substances can be made: Calcium carbide (used for generating acetylene gas), carborundum and artificial gems. The current can be controlled by a lamp bank made up of a number of 110-volt lamps (D. C. is best employed), as indicated in diagram. A water rheostat can also be used for the current regulation. Contributed by

ALFRED GWYNNE.

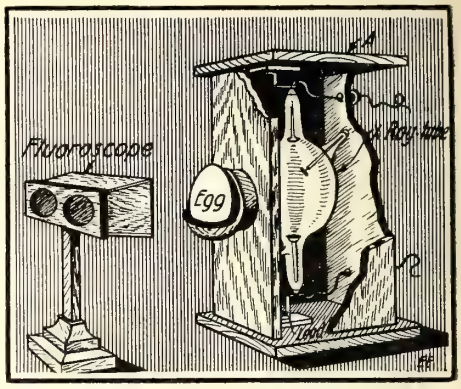


Simple Electric Furnace.

INSPECTING EGGS WITH X-RAYS.

Eggs are now being examined by X-rays, and this new method is said to be a very good one.

A special darkened room is installed in the quarters where the eggs arrive and the apparatus consists of a closed lantern containing an X-ray tube. In the front of the lantern is a small opening about the size of an egg, so that the rays can pass through the egg. The rays throw a shadow of the egg upon a fluoroscope screen placed in front. Fresh eggs are seen to be quite clear, but any defects are shown up as spots appearing on the screen. Such eggs are put in the second class, but if the spots are too large they are rejected. It is well to have a sheet lead front in the box A to screen off the rays not necessary in inspecting the egg.

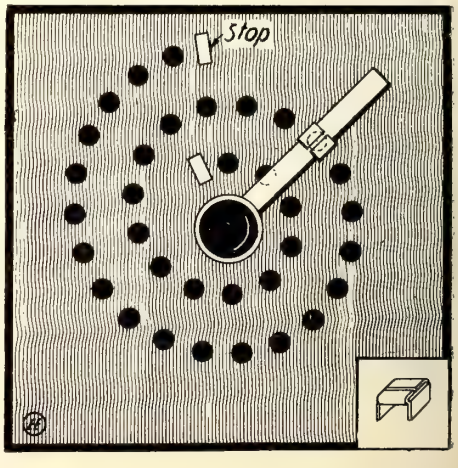


X-Rays Used to Test Eggs.

UNIQUE COUPLER SWITCH.

The multi-point switch, shown in sketch herewith, provides a large number of switch points in a small space. This is accomplished by arranging a sliding contact shoe of thin copper or brass, as perceived, and as the switch arm is rotated this movable or sliding contact shoe gradually works outward from the center of the switch, at the same time making contact with each successive switch point, as will be apparent.

A fiber stop may be mounted, as shown, so as to prevent the switch shoe from moving past the final contact points either way. These stops are made level with the tops of the switch points, of course, so that the lever can pass by them, but so as the shoe cannot.



Unique Switch Enables Use of Many Contacts in Small Space.

Contributed by E. L. H.

RADIO DEPARTMENT

Tufts' College Professor Devises New Wireless Control Scheme

A NEW scheme for controlling various kinds of mechanical apparatus by means of wireless waves properly developed and propagated from an antenna has been devised by Prof. B. K. Shepard, of Tufts College. Our illustrations show Prof. Shepard's apparatus as used in demonstrating his new system of radio control. It is said to be different from that involved in the well-known "Hammond" apparatus of this character, and also this new arrangement does not make use of any ground or "earth" connection, as is usual with practically all other systems of this type.

The first illustration shows the inventor holding his transmitting apparatus, which is quite light, as will be evident. This employs a spark similar to other radio systems and the waves are sent out from the vertical metallic antenna rod and the etheric waves set up are intercepted by the vertical antenna of the receiving set, mounted on a table.

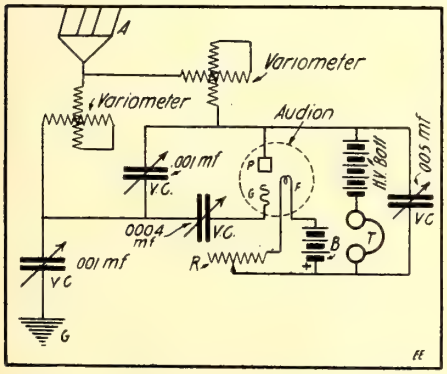
By means of this apparatus it is possible to ring bells, start and stop motors, operate semaphore arms, light lamps, steer a miniature auto, navigate a 7-foot model boat, fire a cannon, etc.

Prof. Shepard is now at work on a wireless submarine boat destroyer. This apparatus, as so far developed, employs no ground connection, as previously mentioned, and in case a torpedo fitted with this device misses its mark, it can be steered back to the sender, in virtue of the wireless wave control involved in its operation.

The second illustration shows Prof. Shepard operating a miniature automobile, and the little girl in same is his young daughter, Miss Leonora Shepard.

A NEW AUDION RECEIVING CIRCUIT.

Herewith is illustrated a new receiving circuit employing two variometers and four variable condensers in connection with an audion detector. With these condensers, having maximum capacity, it was found that best efficiency can be realized. Each variometer, as well as condenser, is independently tuned and a regular audion hook-up is utilized, as perceived, with the exception that across the phones and high-voltage battery a variable, high capacity condenser is shunted. Very sharp tuning is readily accomplished with this new circuit and static is practically eliminated.



Improved Audion Hook-Up With Variometers for Sharp Tuning.

SAYVILLE WIRELESS STATION COMPLETED.

The Sayville wireless station, recently taken over by the United States Government from the Atlantic Communication Co., is now completed and is one of the largest stations in the world. The fourth of the new reinforced towers has just been finished. This makes a total of 11 towers.

The new powerful 100 K.W. transmitter makes direct communication with Germany easy, regular and intelligible.



Above: Prof. Shepard Holding His New Wireless Control Transmitting Set. Receiving Set with Various Devices Mounted on Switchboard.

At Right: Prof. Shepard's Daughter Enjoys a Ride in the New Radio Controlled Automobile. No Ground is Used.

Photo (C) International News Service.

HAMPTON, IA., GETS RADIO TIME.

Hampton will soon be one of the few small cities in Iowa to receive correct time signals by wireless direct from Springfield, Ill., and Arlington, Va. C. H. Haney has had an aerial wire installed extending from the top of the standpipe to the tower of the court house and thence to the roof of the Rule block, and wires will lead from there to an instrument in his store, enabling him to get the time by wireless direct. For the present he will be able to receive messages only, but later an apparatus may be installed enabling him to send out signals also.

The November issue will eclipse even the present one. Don't miss it.

WIRELESS STATION IN CAMP.

A wireless station has been set up by David Meirowitz at S. Melnik's cottage on Orlando avenue, at Pontoosuc Lake. The aerial has only one wire 200 feet long. After some experimenting very good results have been obtained.

A UNIQUE CHEMICAL RADIO AMPLIFIER.

At last an amplifier for the radio amateur, which will boost incoming wireless messages *fifteen hundred times* their original audibility in strength of signals, has been devised.

This new amplifier consists of a special chemical placed between two electrodes which arrangement changes the resistance by virtue of a diaphragm attracted to an electro-magnet. This will be more clearly understood by referring to a cross-section view of this instrument, which is depicted in Fig. 1. It consists of a permanent magnet A, supporting a metallic case N, having a threaded screw cap M. The case contains the amplification parts, comprising the electro-magnet B, which has a small iron core E connected to a very fine steel diaphragm D, carrying a cup F upon its surface. Another cup G is placed on the opposite side and within it, the (secret formula) chemical is placed at I. A tube H is provided so that the material is retained within the cups. The cup G is connected to a threaded rod J and lever K, supported by a rubber standard L on the steel magnet A. The diaphragm D is gold-plated in order that the chemical will not affect the steel. The electro-magnet B is connected by means of the wires O, while diaphragm D is joined to wire P. Rod J connects to terminal Q. The complete amplifier is shown in Fig. 2. The knob at the front is used to regulate the cup G (Fig. 1) and is used in place of lever K. This is done in order to regulate the pressure on the chemical mixture between the cup electrodes.

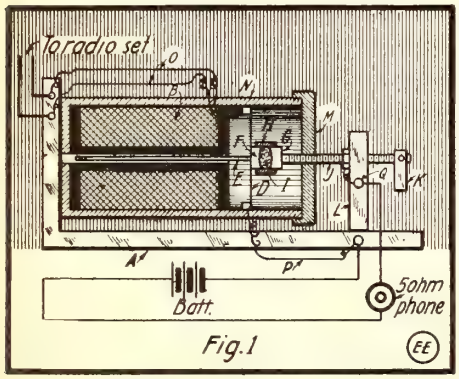


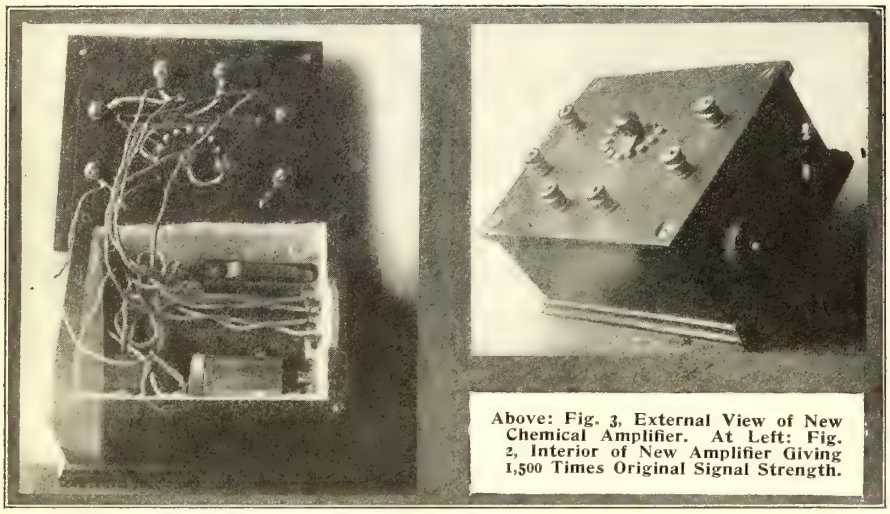
Fig. 1. Diagrammatic View of New Chemical Amplifier.

The action of this amplifier is somewhat microphonic, and as the diaphragm is caused to vibrate by the incoming signals it varies the distance between the electrodes, consequently varying the resistance of the chemical and thus also the phone circuit. A 5 ohm 'phone is used in connection with this apparatus, so it is perceived that a large current is used in this secondary circuit. A horn is usually fitted to the receiver so that messages can be readily heard around the room without using a pair of head 'phones. If two or more of these units are used in tandem signals can be boosted to such an audibility that one cannot stay in the room on account of the terrific loudness of the signals. These amplifiers are also used in long distance telephone work and also for detective work on account of the remarkable sensitiveness.

L. Bishop, the inventor of this wonderful instrument, has spent four long years experimenting on different types of amplifiers and has found after more than a thousand different experiments that the chemical amplifier of this type gives the best results. Fig. 2 depicts the interior of the amplifier, while Fig. 3 illustrates the complete apparatus in cabinet.

Receiving Wireless Messages With Odd Aerials

THE composite illustration shown on the opposite page indicates a number of odd aerials, which may be used more or less successfully under certain conditions for the reception of wireless messages, especially in large cities. The action of these freak aerials is based, of course, upon the fact that they are of metal, and that also they have a distinct electrical capacity and inductance, the same as any regular antennae, used especially for the purpose.



Above: Fig. 3, External View of New Chemical Amplifier. At Left: Fig. 2, Interior of New Amplifier Giving 1,500 Times Original Signal Strength.

The first scheme, shown in Fig. 1, has recently been tried out by a radio experimenter quite successfully, and involves the use of the metal frame and strings of a *Piano* for receiving wireless messages. It may be said that in most of these cases a Ground connection is invariably used, the same as with a regular wireless, and the ground wire may be connected to a gas, water or steam pipe in the building. Failing this, an artificial ground may be provided by driving a piece of pipe several feet into damp earth. Also, the ground wire may connect to a metal plate immersed in a brook, etc.

Of late there has been a great deal heard regarding the use of *Spiral Aerials* where space is at a premium, and Fig. 2 shows such a structure. These are said to work over quite long distances indeed and a great many turns of copper wire are thus provided, which give the entire aerial considerable inductance value, as will be appreciated. The turns of wire can be quite close, even ½ inch apart, the diameter of the turns being 1½ to 2 feet or even more.

Iron *Fire Escapes* on buildings have been used successfully in picking up wireless signals, especially in cities, as seen in Fig. 3.

Another freak aerial, which generally works quite well unless the leader pipes are grounded through iron water pipe conductors, is that shown at Fig. 4, making use of a *Tin Roof* on a house.

A scheme described in detail in the March, 1914, issue of this magazine is indicated at Fig. 5, for the reception of wireless messages, and which employs a *Cardboard Tube* wound closely with a layer of fine insulated magnet wire. This method was tried out by a French engineer, P. Dosne, with considerable success in receiving wireless time signals as sent out by the Eiffel Tower Station at Paris, France. In this case the 'phones are shunted across the detector and the detector in turn is joined in series with a fixed or variable condenser and the inductance coil aforementioned. In this case no ground whatsoever is used. The coil is about 20 inches long; its diameter is 2 inches.

At Fig. 6 is depicted a method which was tried out by Major G. O. Squier, of the U. S. Signal Corps, some years ago quite successfully for short range work. As observed, two large *Iron Nails* are driven into a *Tree* of fair height; one nail is driven in the trunk of the tree *near the ground*, while the second nail is driven in the trunk *just below the foliage*. A tuning coil may be used in series with the 'phone and detector, as the diagram shows, although the coil is not absolutely necessary.

Some experimenters have had quite good success utilizing *Wire Fences* as antennae. A gentleman located on Long Island and at a considerable distance from the Sayville radio station succeeded in picking up the signals from that station very nicely indeed.

At Fig. 8 is shown an idea which is often adaptable to some experimenters' surroundings, and this considers the use of the *steel Elevator Hoisting Cable* as an antenna. A peculiar feature about this scheme is that as the elevator goes up the wave length becomes less and thus, if the elevator is doing service pretty regularly, there is provided an automatic tuning system for the lucky experimenter making use of this make-shift aerial. If he should happen to use this scheme in such a building as the 60-story Woolworth skyscraper in New York City he would have indeed quite a range of wave lengths automatically tuned in and out several times a minute!

A scheme which has been tried out by H. Gernsback some years ago with considerable success in New York City consisted of pasting or temporarily pinning *Tin-foil Strips* on the wall of the room, as Fig. 9 portrays. Needless to say, all of the foil strips are overlapped or pinned together so as to make the whole act as a single capacity area. In these experiments he used some 50 square feet of tin-foil.

Another substitute for the regular antennae is a *metal ceiling,* as pictured in Fig. 10.

The scheme at Fig. 11 utilizes a *Metal Bed,* such as a brass or iron structure, for an antenna.

Even *Umbrellas* with their metal ribs will serve for the reception of wireless signals, as Fig. 12 indicates.

In all the diagrams here outlined a 1,000-ohm 'phone is preferably used, or better yet, a pair of them, together with a sensitive mineral detector using galena or silicon, which requires no battery.

It goes without saying that where these

(*Continued on page* 296.)

RECEIVING WIRELESS MESSAGES WITH ODD AERIALS



Full Explanatory Text on Opposite Page.

Telemechanics or Control by Radio Waves

THE science of controlling distant machines or devices, such as boats, airships, or torpedoes, has been brought into the public eye very prominently in the past few years by the successful researches of John Hays Hammond, Jr., and several European scientists. The possibilities and usefulness of "telemechanics," as this branch of wireless science is termed, is of great importance in time of war. How do we know that some of the war vessels reported as blown up in the present war by mines were not blasted into eternity by a sharp-nose torpedo guided by invisible etheric waves?



Fig. 1. A "Gabet" Radio Controlled Torpedo in the River Seine, France.

Some six years ago the French tried out a successful wireless torpedo controlled from shore by a radio sending station. A view of one of these demons of war gliding swiftly through the waters of the River Seine is shown in the photograph, Fig. 1. This particular torpedo carries antenna structures above the water, as perceived, and was perfected by M. Gabet.

A most interesting phase of this subject is how can it be done without the etheric waves from various radiotelegraphic stations interfering with it, causing it to become erratic in its behavior or changing its course? It may be said that some of the finer developments of the art of telemechanics are pretty well locked up in laboratory note books as yet, but, however, a few methods of interest to those interested in such work are cited here.

In the diagram, Fig. 2, is outlined the plan for rigging up a small model boat with propelling motors, batteries, wireless control devices, aerial, etc. The boat may be made of tin or galvanized sheet iron, soldering all the joints. Details are not mentioned on the design of the boat, as most readers would probably prefer to make or use a stock form procurable cheaply from most toy stores.

Let us now take up the scheme of radio wave control applicable to such an experimental model. One of the simplest means, theoretically (and also practically if the proper apparatus is used), such as a quenched spark transmitter, etc., is shown in the diagram, Fig. 3. The basis of this whole scheme now under discussion is the accurate transmission and reception of sharply tuned waves having different lengths or vibration periods.

The arrangement is not complicated, although it may appear so at first sight. At the sending station an aerial A_1 is connected to a variable tuning coil B. It is supposed that several wave lengths or tunes are obtainable in this way, each wave being several hundred meters, if necessary, different in value from the next nearest wave. For instance, suppose the six steps shown vary from each other by a difference of 200 meters. If the switch lever B on step 6 gave a wave length of 400 meters, then step 5 would give 600 meters, etc. As the wave is changed in the aerial circuit A-B-G the closed oscillating circuit C-Q-D is simultaneously varied in proportion so that both open and closed oscillating circuits are in syntony or tune.

If a good quenched spark transmitter is employed the tuning will be very sharp, as we well know. The transmitter may be a spark coil, but preferably a small transformer working on 120 or more cycles frequency A.C. A Clapp-Eastham "hy-tone" set will create sharp tuning facilities on 60 cycles.

So much for the emitting of the successive tunes or waves. At the receiving station on the model boat or other device several attuned circuits are provided. Each properly tuned receiving circuit contains a coherer C_1, C_2, C_3 and C_4. Each coherer actuates its own relay R_1, R_2, etc. The relays in turn control their respective local circuits through batteries B, B_2, motor A_2, motor B, etc. All batteries can be of the flashlight type.

Every coherer circuit is properly attuned to the various emitted wave lengths by means of tuning coils L_1, L_2, L_3, etc. These inductances may be shunted by variable condensers to more sharply tune the circuits. Also the coils are best made adjustable. A common antenna A serves all the resonant circuits, as well as a common ground G, which can be the metallic hull of the boat.

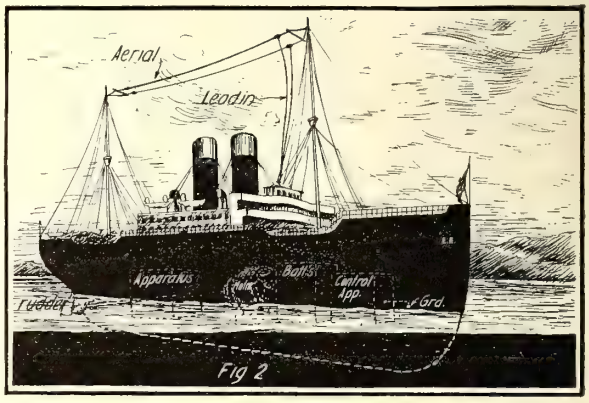


Fig. 2. Miniature Boat With Radio Control Set on Same.

To simplify matters permanent magnet field motors are utilized at A_2 and B, which motors, if on a boat, may control, say, the rudder and propeller. To cut off the motor current from A_2 or B two extra tuned circuits with coherers and relays are necessary, but are not shown for the sake of clearness. As the various waves of differing lengths are sent out from the transmitter the corresponding coherer and relay circuits respond actuating their respective motor circuits.

Two sets of batteries are used to control one motor of the type mentioned, and by passing the battery current into the motors in opposite directions alternately by the relays R_1 and R_2, for example, the motor is caused to rotate right or left handed, as the case may be.

This is only one idea for radio control and many others have been worked out. One of the simplest, but disadvantageous in that prompt selective control is not possible can be had by utilizing the old step-by-step relay with a ratchet wheel and pawl. A solenoid or plunger type electro-magnet acts on a pawl tooth, as seen in Fig. 4, serving to pull the drum and switch lever S around step by step over the various circuit contact buttons, 1-2-3, etc. The contacts are usually arranged in a circle.

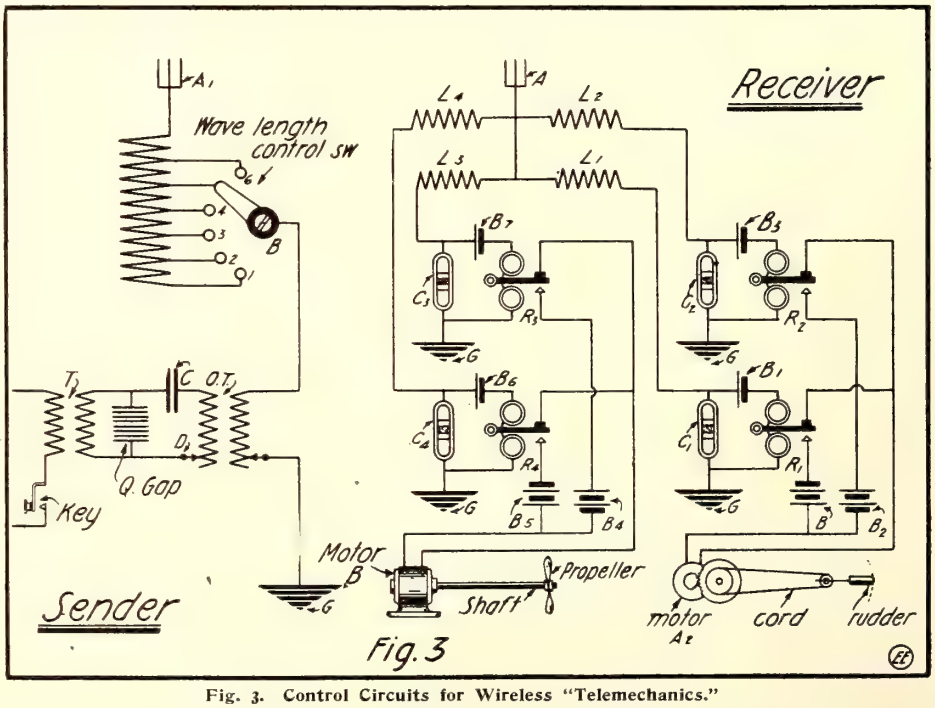


Fig. 3. Control Circuits for Wireless "Telemechanics."

A very unique scheme said to be practical is illustrated in the diagram, Fig. 5. Here the selenium cell is brought into play, which, as is well known, changes its electrical resistance in direct proportion to the strength or amount of light thrown on it. In this manner a relay is operated with a selenium cell and battery in series. If the relay be adjusted so it does not close its local circuit with the selenium cell in the

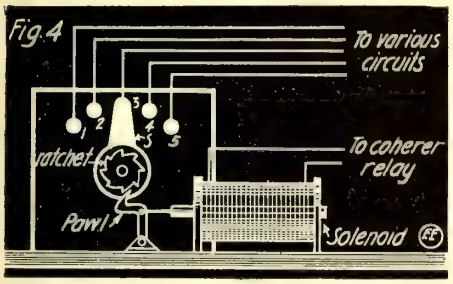


Fig. 4. "Step by Step" Radio Control Relay.

dark, then, when the cell is exposed to light, its resistance falls from 1/4 to 1/6 or more of its dark resistance, and the relay deriving more current from the battery will close.

The complete theory of Fig. 5, however, goes further than this and takes into consideration the latest discoveries in the art, which made known the fact that under certain physical conditions selenium will perform its function best as above explained when a certain *colored light*, corresponding to a definite etheric vibration frequency, is projected against it. With this in mind, a working arrangement possible is hypothecated at Fig. 5, where a powerful searchlight A is caused to project various colored beams of light on to the parabolic reflector R.F. In the focus of this reflector are grouped the battery of selenium cells 1-2-3-4, etc. Each cell operates a distinct relay, as did the coherers in Fig. 3. If a red light is thrown on the selenium cell, then a "red-sensitive" cell responds, causing the device carrying it to act accordingly.

This new science is undoubtedly only in its infancy, and at the toddling age at that, so that the wireless fiend will find plenty

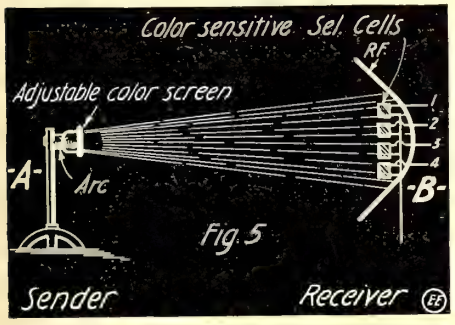


Fig. 5. Using the Selenium Cell for Wireless Control.

to keep him busy in this useful branch of the wireless art.

MEMBERS OF RADIO CLUB TO PREPARE FOR COMMERCIAL LICENSES.

A course of lectures and instruction will be given to the members of the Connecticut Valley Radio Club beginning with its next meeting, and after finishing the course the members are expected to be prepared to take the examinations in Boston for first-grade commercial licenses. The future meetings, which will begin the season in wireless telegraphy, will be featured by wireless telegraphy apparatus loaned by the various manufacturers.

Efficiency in the Amateur Radio Station

By Thomas W. Benson

EFFICIENCY in wireless telegraphy resolves itself in getting the longest range and the loudest signal obtainable with the apparatus in use. Of course good design is necessary, but the object of these paragraphs is to point out the best methods of utilizing instruments that are really unfitted for radio work.

For instance, take the amateur who possesses an X-Ray coil. It gives a long thin spark, ideal for the purpose for which it was designed, but in the average set its efficiency is very low, due to the fact that most articles describing the use of coils for radio telegraphy take it for granted that the proper coil is employed, and deal with the standard apparatus in connection with it.

A coil of this description when connected, as shown in the usual hook-ups, gives a long wave or else a highly damped wave. The first is the result of the enormous amount of capacity used to shorten up the spark gap. A short gap is necessary if the decrement is to be kept low, as the spark gap is a form of resistance which affects the decrement. On the other hand,

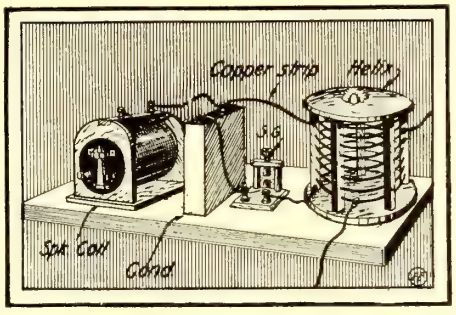


Fig. 2-A. Compact Arrangement of Wireless Sending Set on Shelf.

if a small condenser is used to keep within the 200-meter limit, an extra long gap is necessary and a broad, highly damped wave is emitted. The latter evil is the less noticeable because the Government stations will pick up and observe a long wave, paying little or no attention to the badly tuned wave if under 200 meters.

The proper method of employing an X-Ray coil for wireless telegraphy is sketched in Fig. 1. Here the coil is used without condensers, the aerial itself acting as the capacity, while a lumped inductance, I, is connected in the aerial lead. The gap used is of the compressed air type where the spark occurs in air at a pressure of two or three atmospheres. The exact design of the gap is left to the reader, but one that can be easily constructed is shown.

The container is an ordinary Mason fruit jar, one-quart capacity. The standards are mounted on a piece of hard rubber and the pressure is created by a hand bulb acting through a check valve. Soft rubber gaskets are used to render the whole air-tight.

This method gives a sharp wave of good carrying power and with a very small gap it may be used with coils under one-inch spark length, whereas the helix cannot be employed very well.

Another point overlooked in amateur wireless stations is the relation between interrupter speed and the high tension condenser. The usual practise in determining the proper condenser is to build one with as many plates as the constructor happens to have. If this condenser stands the discharge of a two-inch coil, it is a two-inch coil condenser. If someone else finds that a three-inch coil does not puncture it, it then becomes a three-inch coil condenser, and so on indefinitely.

It is also true that from time to time

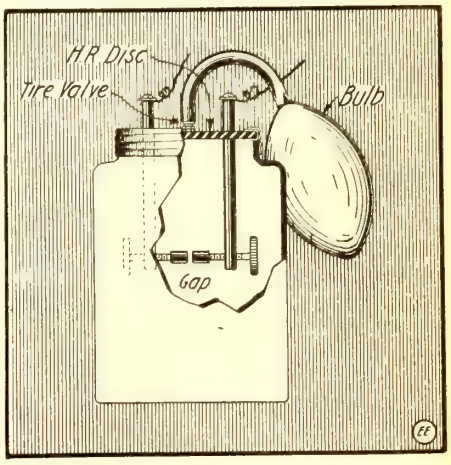


Fig. 2. Home-made Compressed Air Spark Gap.

tables appear in the various journals, stating the number of plates to use with the different size coils. These tables are very good, invaluable in fact when followed out properly, but many amateurs make a serious mistake in trying to obtain a very high pitch note with these condensers. They have, in most cases, speeded their interrupters up to the limit; when, of course, these condensers have been adapted for use with a medium speed interrupter. Therefore, it is necessary to adjust the voltage and speed of the interrupter for best results or efficiency.

I will not deal with spark gaps here, as they have been well covered in the past, but one thing necessary is to keep them cool by radiating wings, air blast or damp-

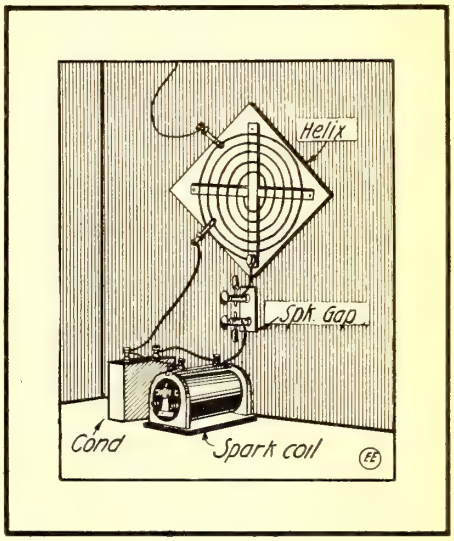


Fig. 2-B. Short Wiring Possible for Radio Set on Table and Wall.

ened sponges, and let me suggest that a vertical gap be used instead of a horizontal in straight gap sets. In rotary and quenched gaps this is not so important.

I have also noticed a number of articles on synchronized rotaries to be used with spark coils. A much better way is to use the interrupter end of the device and use a quenched gap instead of the rotary. Less noise and more satisfactory results are obtained. Efficiency again!

By all means keep the leads as short as

possible, both on the sending and receiving sets. Arrange the instruments in proper order. If your sending set is on a shelf, Fig. 2, "A" offers a suggestion for short wiring; if on a table and the gap and helix are fastened to the wall, the second sketch, "B," will be found of service. Use copper

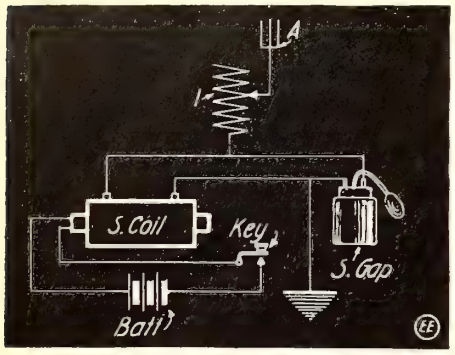


Fig. 1. Connections for Compressed Air Spark Gap.

strip for the sending set connections, not "bell wire"!

The aerial switch is another energy-wasting device. It puzzles me why amateurs persist in using a switch, which requires the best of insulation and is always more or less bulky, when a small switch properly connected is much better, or even a telephone key may be used. In Fig. 3 a hook-up is shown that has the usual aerial switch beat for several reasons. The first is that leakage does not affect the results, thus making it cheaper and easier to construct. Secondly, it enables a symmetrical wiring diagram to be used. The aerial enters at top of window, runs to helix, then to switch and thus to ground. An easier, better method is impossible. The hook-up, using a telephone key, is also added. This may be mounted on a table and the change-over can be made in an instant with the small finger. Who wants to use those big switches now?

Turning to the receiving set, most losses are incurred in dead ends, poor contacts, detectors and *poor* condensers.

To overcome dead ends, use fixed inductances and use variables for tuning. The primary of the coupler should have about 40 turns of No. 24 S.C.C. copper

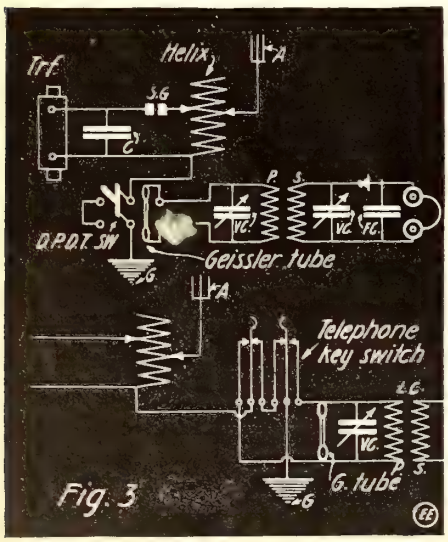


Fig. 3. Simplified Transmitting and Receiving Radio Hook-ups.

wire and the secondary 60 turns of No. 28 S.C.C. The tubes may be 4 inches and 3½ inches in diameter, respectively. The variables, of a good commercial make, as

An Almost Human Wireless Receiving Set

An automatic receiving outfit, an "almost human radio receptor," was the title given to his latest device by Mr. Walter Goodchild, the well-known inventor of the "Permanent Wireless Detector" and other scientific apparatus.

This receiving set is operated entirely by an electric motor, as depicted in the center of the illustration at Fig. 1. This motor operates the various mechanisms by pressing any of the control "keys," portrayed on the front panel, each of which performs a certain distinct function.

The complete machine comprises a specially designed inductive coupler, which consists of four reels containing a copper ribbon, one side of which is coated with a special flexible insulating compound. These reels are wound and unwound as required by the motor. Two sets of coils, one pair of primaries and one pair of secondaries, are provided, as Fig 2 shows. The inductive value between the primary and secondary is changed by moving the secondary back and forth parallel with the primary; this is accomplished by the same motor, operated by a different key. A scale and needle indicates this inductive value, as seen in the upper part of the instrument at Fig. 1. The dial indicator moves according to the position of the secondary coils. The dials on each side of the machine denote the *wave lengths in meters*, corresponding to the position and amount of ribbon in use on the coils.

Two specially designed variable condensers, placed on each side of the apparatus, are illustrated in Fig. 1. These are driven by two separate electric motors, also operated by control "keys" located on the right hand corner of the instrument The condensers are of the variable plate type, i. e., instead of varying the dielectric as in the ordinary variable condenser; the number of plates in use are actually connected and disconnected electrically by changing the position of the plates. This is accomplished by the motors and in this way the condensers are absolute and reliable in their work. Here the proper dials depict the *capacity of the condensers* in the regular units.

The detector is of the permanent type and is located inside of the case, as also the batteries for driving the motors. The central switch is used to vary the current supplied to the detector.

The operation of this remarkable set is very simple, requiring merely a pressure on the right "key," and watching at the same time the dial indicators to see that the proper wave length is tuned for. It has been found in testing it out that it takes only 11 seconds to change the wave lengths from 200 to 8,000 meters. The set can easily be carried about, as it is very compactly built, adapting it for use on aeroplanes, battleships, automobiles, etc., as the keyboard can be located in any place desired.



Front and Back Views of Improved Radio Receiving Set That is Almost Human in Its Working. Fig. 1, Above; Fig. 2, Below.

compared with home-made variables (which are nothing more than makeshifts nine times out of ten), should be connected on parallel with the windings. Wave lengths up to 300 meters may be tuned on this coupler; the exact length depending, of course, on the length of the aerial. To receive longer waves a second coupler should be constructed, using 200 to 250 turns on the primary and secondary, respectively. A switch is arranged so as to throw from one coupler to the other, and the fear of "dead ends" is removed. The above construction does away with sliders and switches, thus lessening chances of poor contacts.

The detector is a trouble maker and many devices have been produced to obliterate this. Galena is the favorite and a stand for this excellent detector should be selected that is sturdy, simple and provided with fine adjustments.

All condensers should have an air dielectric, even the blocking condenser. A good blocking condenser may be made from 70 sheets of aluminum, 4x5 inches, mounted in a case and separated from each other by strips of mica at each end. This condenser should be adjustable by a suitable switch. This is another factor for obtaining loud signals, which is often overlooked, as nearly every set of receivers requires a different capacity. The reason for this has puzzled many, but still the fact remains. However, it may be more clearly understood when the 'phones and blocking condenser are considered as an oscillatory circuit tuned to a certain harmonic of the secondary circuit. As a general rule, the higher the resistance the smaller can be the blocking condenser capacity.

In closing, I would say, run parallel wires as far apart as possible; cross all wires at right angles and solder each and every joint.

WIRELESS SAVED GERMANY MANY MILLIONS.

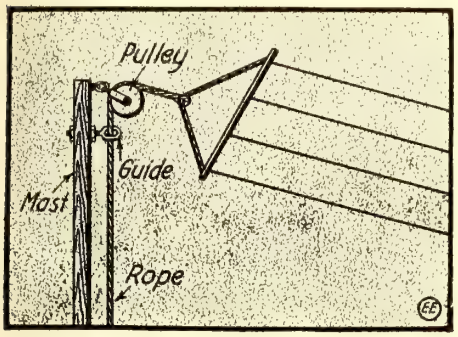
"War has been declared on England. Make as quickly as you can for a neutral port."

This message, flashed for a radius of 2,000 miles over the system of world-girdling German wireless telegraph stations at 5 p. m. on Aug. 4, 1914, saved Germany the bulk of her merchant marine, according to Godfrey Isaacs managing director of Marconi's Wireless Telegraph Co., London, England, at a meeting of the company.

The saving of the Hamburg-American liner "Vaterland" alone, he added, more than balanced the $10,000,000 Germany had expended in erecting the stations.

GUIDE FOR AERIAL ROPES.

A simple but efficient rope guide for an aerial pulley may be made from a ¼-inch bolt about 6 inches long and a couple of nuts. The bolt is bent, after the head has been cut off, in a circle to fit the rope. A hole is then bored into the aerial mast to



Guide for Aerial Ropes to Prevent Jumping Off Pulley.

fit the bolt, and a nut is put on each side of the mast. The guide should be placed about 3 or 4 inches below the pulley. This simple device often saves much trouble when the rope catches in the pulley. Contributed by W. R. MILNER.

LOOSENING CORRODED BATTERY TERMINALS.

It is sometimes very hard to loosen the terminal nuts on storage batteries. This is often true when no great care has been taken to see that the terminals were free from the acid used in the battery before the terminal nut was screwed on. In cases where these nuts "stick" it should be remembered that if too much force is used the terminal is likely to be torn off bodily.

The best method that I have found to remove them is to use a pair of pliers which have been made fairly hot and to hold the terminal nut with them until the terminal parts are heated through. The nut will then turn quite easily. It is well to cover the screw threads of the terminal with vaseline, after cleaning them thoroughly from acid, before the nut is applied. If this is done there should be little trouble from corroding.

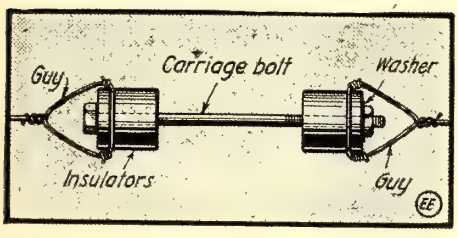
Contributed by

MILTON E. SAUL.

[Soaking the terminals in strong ammonia for 30 minutes accomplishes the same purpose.—*Editor.*]

AN INSULATED TURNBUCKLE.

Here is an easy way of combining the insulator and turnbuckle on the guys of a wireless pole into one piece, thus strengthening the guys by not breaking them up into several parts to insert insulators and turnbuckles.



Insulated Turnbuckle.

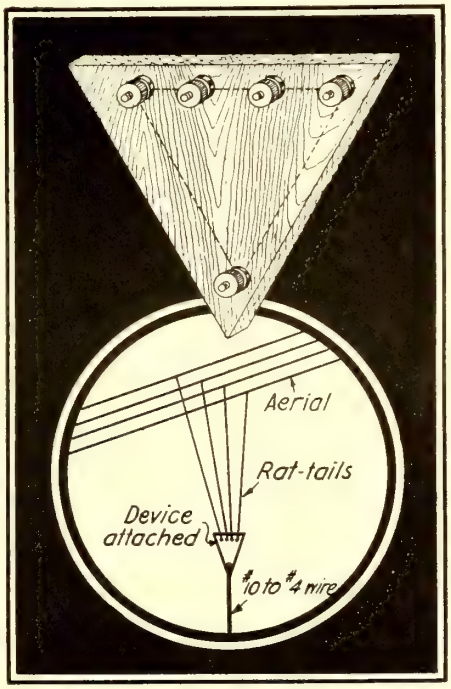
The insulated turnbuckle herewith described consists of three parts, namely, the turnbuckle, which in this case is an ordinary 7-inch carriage bolt having a diameter of ¼ of an inch, and two standard porcelain insulators. They should be arranged as shown in diagram. To tighten the guys it is only necessary to tighten the end nut of the bolt.

AN EFFICIENT AERIAL CONNECTOR.

Many wireless troubles result from loose, weak or faulty connections, and the device described and depicted herewith practically eliminates all troubles arising therefrom.

It consists of a simple block of hard wood, shaped somewhat like a triangle, as shown in sketch 1. It should be boiled in wax. Four holes are bored at the top of the block to admit four binding posts from "dead" dry cells. Another hole is drilled at the bottom, where the two sides of the block meet, for the same purpose. Insert loosely all the posts and then take some No. 14 aerial wire and lead around all the posts, arranging as per dotted lines, from one to the other. Small grooves may be made on the back of the block and wire squeezed snugly into these. Tighten the nuts on the posts and fasten the rat-tails and lead-in to posts.

The illustration clearly shows the device attached, but it may be stated that all such "connectors" usually extend down from about 15 to 25 feet from aerial. Lead-in



Antenna Connector Made of Wood.

can be made of from No. 10 to No. 4 wire.

Contributed by WILLIE WOTON.

SOME PRACTICAL HINTS.

A short permanent horseshoe magnet fastened to the end of a stick is a most handy article for locating and recovering small screws dropped to the floor from the work-bench. You do not have to get off your seat and get down on all fours to hunt for them. Slide the magnet slowly over parts of the floor and soon the screw will be found attached. *(Provided it ain't a brass one!—Ed.)*

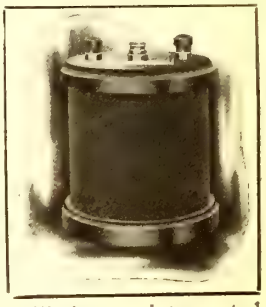
Plain newspaper rolled into a small tube makes a cheap and handy brush for applying lacquers, etc., and also saves the trouble encountered when you failed to clean the brush last time and wish to use it again.

Often it is desired to know if an arc lamp is being fed by A. C. or D. C. A sure and quick test can be made by taking a hexagonal pencil and holding it at one end, and slowly pass it horizontally from side to side before your eyes. If A. C., the pencil seems to rapidly revolve in the hand; if D. C., it appears to be at rest in the hand. Contributed by

GUY H. DALTON.

NEW BUZZER TEST RESONATOR COIL.

A new and effective buzzer test circuit intensifier, in the form of a specially wound inductance, has recently been perfected and placed on the market. The illustration depicts the appearance of the resonator coil, and it is claimed that adjusting radio detectors becomes a pleasure with this resonator, when connected in series with the buzzer test circuit wire.



Presumably the device acts to increase induction in the circuit, and as the buzzer test currents are a series of rapidly oscillating or interrupted currents it is evident how this inductance in the circuit can "boost" these currents so as to give a magnified effect when they reach the detector and phones.

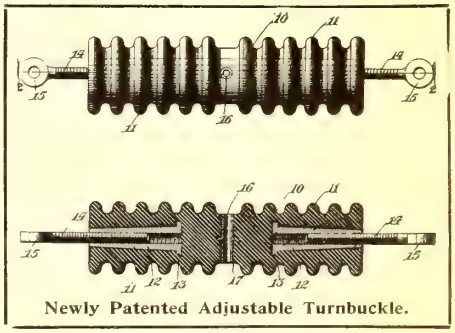
It is said to be particularly efficacious when utilized in conjunction with the well-known Crystaloi detector. It is finished in hard rubber composition and is a neat addition to any radio receiving set.

NEW TURNBUCKLE INSULATOR.

A useful form of strain insulator has been patented, and description follows:

The device as completed forms a turnbuckle having a body or shank of insulating material 10, and having threaded eye bolts engaging threaded bolt-receiving members 12 imbedded in the ends thereof, and these bolt-receiving members are in turn firmly anchored in the insulating body so that the device will possess great mechanical strength. Its insulating value is also very high, since the terminals are separated by the body of the insulating material in which they are imbedded.

The device can be adjusted to tighten or loosen the wire or cable in which it is inserted by rotating the body or shank 10. This can be done by inserting a tool such as a rod or screwdriver into the central hole 16 so that a great leverage may be obtained. This central hole is lined with a metallic sleeve so that abrasion of the brittle insulating material will be prevented, since the tool engages and transmits the force through the sleeve 16, which is imbedded in the insulating body. The sleeve 16 is positioned between the ends of the sleeves 12, and is therefore insulated from both of these sleeves and from the eye bolts and the wire in which the device



Newly Patented Adjustable Turnbuckle.

is inserted; the device may therefore be adjusted to tighten or loosen the wire without danger of shock even if one of the eye bolts is connected to a high-tension wire.

THE "BRODIE" DETECTOR.

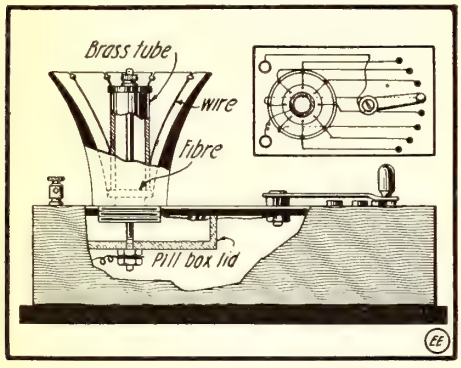
The subject of detectors has been well covered in the past by this magazine, but I believe the one herewith described deserves a place on the list. I have nicknamed it the "Brodie" detector, as the element of chance is foremost in adjusting it.

The principal part consists of a microphone mouthpiece with 10 saw-slots one-eighth of an inch deep, spaced equidistantly around its edge. A small wooden box, 5x3x1 inches, forms a very good base for it. In addition you will need the following: 10 switch points, 1 switch lever; 2 binding posts; 1 threaded brass rod 2½ inches long, and 2 nuts for same; one ½-inch inside diameter brass tube, 1 inch long; 1 fiber washer, ⅝-inch diameter; 1 lid of wooden pill box about 1½ inches diameter; 10 pieces soft brass wire about No. 24.

The mouthpiece (after the slots are cut) should have the perforations in the center knocked out, but the outer row of holes should be left intact.

Take the brass wire, tie a knot on one end, put each wire in a slot with the knotted end outside and run the wire down the inside of the mouthpiece and through one of the holes of the perforated shield at back.

After putting all the wires in place, lay it aside. Now take the box and cut a hole one inch from one end to allow the thread



Multiple Contact "Brodie" Detector.

on the mouthpiece to fit in without slipping through. At the other end lay out and drill holes for a ten-point switch, as shown in illustration. Drill holes for binding posts at back. After staining woodwork to suit taste of builder, we can assemble the various parts.

The drawing will be of great assistance in assembling, therefore it should be closely studied. Place the transmitter mouthpiece in place in the hole and carefully separate wires inside of the box. Take the pill box, which has a hole drilled through the center large enough to pass the threaded rod. Put rod through it with nut on end, pass up through center of mouthpiece, drop fiber washer over rod, then the brass tube, a washer and finally the other nut. Center the tube and screw up tight after drawing the brass wires taut. Connect each wire to a contact on the switch, threading a band of paper or thin fiber between them, so they don't touch.

After connecting one binding post to the center brass tube and the other to the switch lever, the detector is ready for use.

To use, break the galena up into pieces about as large as a pea and drop into mouthpiece around center tube. The switch is quickly moved from point to point until an adjustment is found.

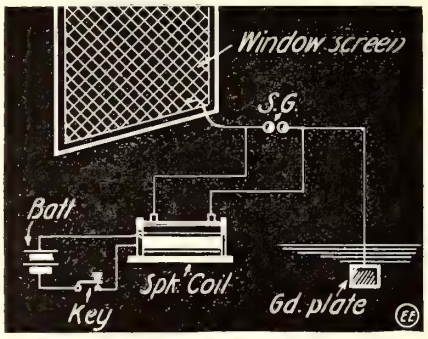
Although there is no law of physics that states that a sensitive spot will be found, it is surprising to get at least two points to respond on the first trial, if the mineral is at all good.

With the assistance of the drawing I believe the description sufficiently clear to allow of the amateur building this instrument, which will always be ready in a pinch. Contributed by

THOMAS W. BENSON.

WINDOW SCREEN SERVES AS ANTENNA.

While my regular antenna was down



Window Screen Radio Antenna.

temporarily I experimented with various substitutes.

Upon connecting my receiving set to an ordinary window screen I found that signals from a local spark-coil station about one-quarter mile away were received almost as loud as on my regular aerial. A small transmitting set consisting of an "Electro" ½-inch Bulldog spark-coil, gap and key was then hooked up with this novel antenna and, with the addition of an aerial switch, regular communication was carried on. Slightly better results were obtained by connecting two screens together. Neither station was grounded on water pipes, but to metal plates buried in the ground at each station, so that there was no metallic connection between the two stations. The screen used was of ordinary size and not more than 12 or 15 feet above ground.

When using a sending set with an aerial of this kind it is absolutely necessary that all connections between coil, gap and screen be as short as possible and fairly heavy in order to secure good results.

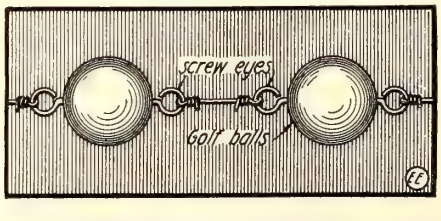
Contributed by

DONALD PALMETER.

GOLF-BALL AERIAL INSULATORS.

A very good aerial insulator may be made from a golf ball, the solid gutta percha kind being the best.

First, it may be well to remove the paint, because it acts like a conductor, due to the lead in the paint; it may be done by applying a coat of paint remover. This accomplished, take a small drill and at opposite ends drill holes a short way in. Now take a few brass screw-eyes and



Golf Balls Prove Good for Insulators.

thread them in the holes made, being careful that they do not touch at the center. By following the drawing, all points will be made clear. These insulators will be found to be very strong and also will resist fairly high voltages. Several may be joined in series to increase the insulation value. Contributed by

F. PELTON.

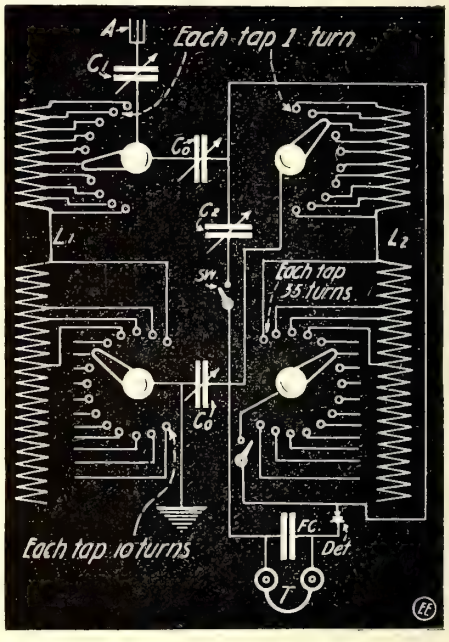
LONG ISLAND BOYS STUDY WIRELESS.

The establishment of the wireless plant in Sayville has given an impetus to the study of the wireless among Sayville, L. I., school boys, a large number of whom have receiving apparatus. A number of them are also members of the Sayville troop, Boy Scouts. They have organized a wireless class under the direction of First Class Electrician Dunkie, who is a Government operator at the station.

ANENT DR. COHEN'S NEW NAVY TYPE RADIO SET.

In the July issue of the *Electrical Experimenter* I took particular note of Dr. Cohen's improved Navy set and hooked up my set in the identical manner, and must say that the selectivity is wonderful.

However, for the benefit of amateurs contemplating using Dr. Cohen's hook-up, I wish to contribute a diagram which was tried out on my set and tested by me. It is similar to the improved style, except that every turn of inductance on the primary and secondary may be obtained.



Modified Hook-up and Construction for Dr. Cohen's New Wireless Receiving Set.

The amateur will find this to his advantage and for sharp tuning it has no equal. Contributed by

HARRY Y. HIGGS, R.E.

NEW CARNEGIE INSTITUTE OF TECHNOLOGY RADIO PLANT.

At a cost of $1,500 the Carnegie Institute of Technology, at Pittsburgh, Pa., is installing in the tower of Machinery Hall a new radio plant which will be the most powerful in that part of the country. The outfit will have a wide range over which it may communicate, the western boundary being Honolulu and the eastern Germany. Communication will also be established with other technical schools throughout the country which have radio equipment.

The other station is being installed for the use of the student Radio Club, an organization of electrical students. The equipment of the new set consists of a 10-kw. motor-generator of the latest design and an Audion detector.

If you are a "newsstands reader," look sharp next month. We are changing the heading of our cover to make it more readable. You will like it, too.

A GEISSLER TUBE EFFECT.

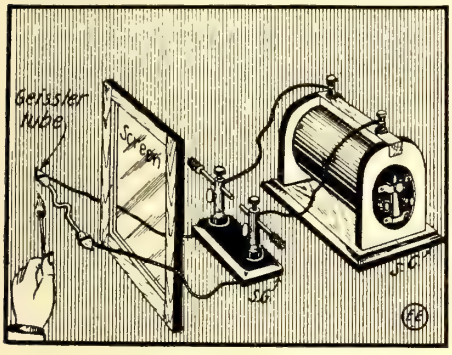
Connect a small Geissler tube to a gas engine or other small spark coil and shunt a spark gap around it, as indicated in sketch. Now adjust the gap so that when the coil is started the discharge will *just fail* to pass through the tube.

If the setting has been carefully made the coil may now be operated without producing a glow in the tube *as long as the tube is kept in the dark.* If a light from the spark gap or any ordinary light be allowed to fall on the tube a discharge will begin at once and will continue as long as the coil is operated. The current may be cut off at any time and the performance repeated indefinitely.

A rather interesting way of showing the effect is to "light" the tube with a match. For the success of the experiment the adjustment must be such that a very slight change in conditions will cause a discharge. The gap must be set apart as widely as possible and the vibrator of the coil should operate very steadily.

My explanation of the effect obtained is that the light thrown upon the tube ionizes the gas, making it more conducting and thus lowering the potential needed to produce a glow discharge to a value below that of the applied potential.

With most Geissler tubes the effect is very difficult to obtain if the regular sealed-in electrodes are used. Temporary condenser electrodes are made by wrapping



Light of Match Starts Spark Through Tube.

tinfoil bands around the tube near each end and the coil leads are connected to these. Contributed by S. KRUSE.

OVER 4,000 MARCONI RADIO MEN IN EUROPEAN WAR.

Presiding at the annual meeting of the Marconi International Marine Communication Company, Godfrey Isaacs expressed the regret of William Marconi at his inability to be present.

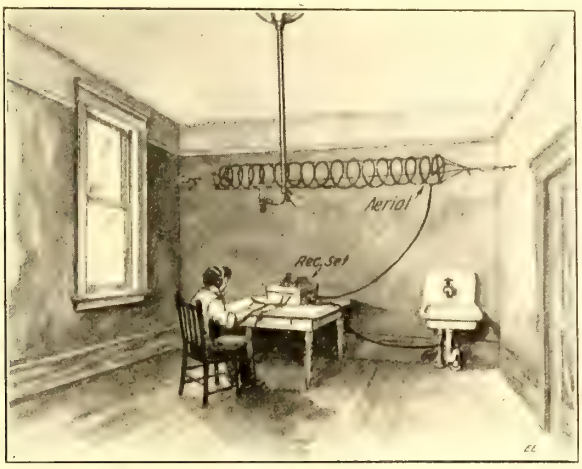
Mr. Marconi, said Mr. Isaacs, had been called upon by his Government and had joined the engineering staff of the Italian Army in order to superintend the organization of its wireless communications. At no time had the value of Mr. Marconi's invention been more prominently emphasized than since the outbreak of the war, and when peace was obtained an interesting chapter might be written of the part played by the 2,000 Marconi stations fitted upon vessels of the mercantile marine.

Over 4,000 Marconi operators, said Mr. Isaacs, were in the service of the British Army and Navy, and the Admiralty had, on more than one occasion, expressed appreciation of the resource and courage displayed by the men.

Now is the best time of the year to erect an aerial or to overhaul an old one. Better get busy.

SPIRAL INDOOR AERIALS.

Where aerials are desired for wireless experimental purposes, etc., in apartments and other places where it is not desirable



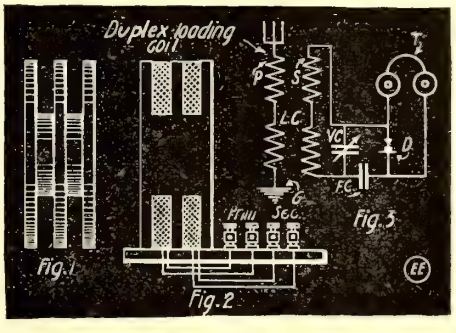
Spiral Antenna for Small Spaces.

to place long stretches of wire on the roof, the newly devised spiral aerial will be found very suitable for the purpose. This form of aerial, of course, possesses a large amount of inductance in proportion to its actual length when opened up. It can be used in an ordinary room, and as it may be made with a large number of turns in same, spaced even as close as ¼ to ⅜ inch, it can be seen that the inductance will reach a large value. Hence its receiving activities and also wave length capacity will be quite appreciable.

It has been stated that with this form of aerial it has been possible to pick up radio messages over distances of 1,500 miles and more. Strings may be used fastened to each turn in the helical aerial, so as to help support same in a straight line, or nearly so, between the end spreaders. These spreaders may be made of two crossbars of wood. Two heavy wireless insulators placed in either suspension rope supporting the aerial will insulate it nicely. It can be composed of 50 to 100 turns or more of No. 14 solid conductor or stranded cable with a turn diameter of 1 to 1½ feet.

A DUPLEX LOADING COIL.

The following is a description of an instrument which should be found in every radio station. It is known as a duplex loading coil, as it allows both the primary and secondary circuits of a loose coupler to be adjusted to long wave lengths. If inductance is added to the secondary circuit and that inductance inductively coupled to the primary circuit very good results will be



Making a Duplex Loading Coil.

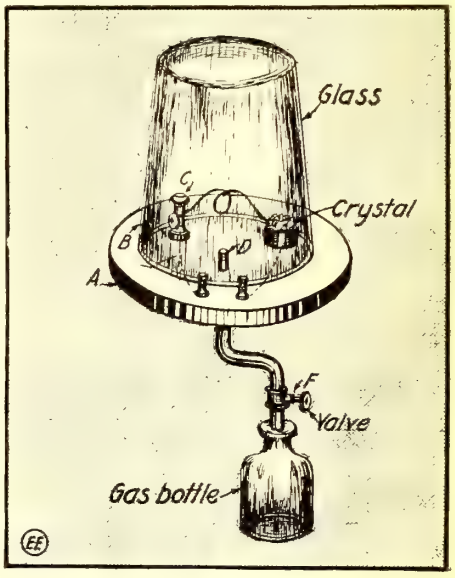
obtained. Of course, increased capacity could be added to the closed circuit, but it has been found that for the loudest signals the inductance employed should be considerably greater than the capacity. The device which will now be described consists of two coils having coupling between them; one coil being connected in series with the primary and the other in series with the secondary of the loose coupler.

Obtain three circles of ¼-inch wood 5 inches in diameter and two discs 4 inches in diameter. Glue these together so that they will appear as in Fig. 1. Wind one of the grooves full of No. 26 S. S. C. wire and the other full of No. 30 S. S. C. wire. The wire should be wound on roughly, crossing the turns as much as possible. Enamel wire should not be used. The coils may then be mounted on a base as shown in Fig. 2, the ends of each coil being brought out to binding posts. Connect up as shown in Fig. 3.—Contributed by IRVING BYRNES.

GAS JACKET FOR DETECTORS.

Herewith you will find notes and drawing on constructing a new form of detector. All the material can be obtained around the experimenter's workshop.

In the drawing A is a circular base having a groove B about ¼ inch deep and the diameter of a good sized jelly glass. C is a detector of the cat whisker type,



Detector in Gas Chamber.

with connections to two bindings as usual. At D a short length of glass tubing is put through the base. Great care must be taken so that it will fit tight.

The detector stand should be firmly fastened down and the glass tubing allowed to go through the table to which the detector is fastened.

Then adjust the detector; put the glass over it and connect a piece of rubber tubing to D. This tubing is connected to a bottle of hydrogen gas which may be caught by a downward displacement of water, etc. A pinchcock should be fastened at F. One will be surprised at the increase in the strength of the signals.

Contributed by RAD COOVER.

[*This suggests a good field for research by the radio experimenter. Tests of different temperatures would also be worth while.*—ED.]

The correct time by wireless from Arlington, Va., will check the clocks and watches at Tobin & Canham's jewelry store in Springfield, Ill.

HOW TO MAKE IT

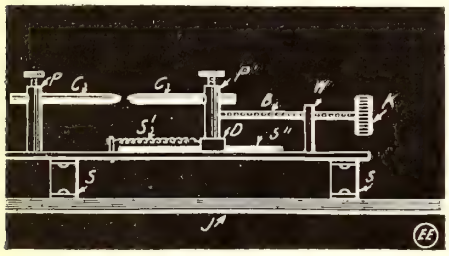


This department will award the following monthly prizes: FIRST PRIZE, $3.00; SECOND PRIZE, $2.00; THIRD PRIZE, $1.00.
The idea of this department is to accomplish new things with old apparatus or old material, and for the most useful, practical and original idea submitted to the Editors of this department, a monthly series of prizes will be awarded. For the best ideas submitted a prize of $3.00 will be given; for the second best idea a $2.00 prize, and for the third best a prize of $1.00. The article need not be very elaborate, and rough sketches are sufficient. We will make the mechanical drawings.

FIRST PRIZE $3.00.

SIMPLE ARC LAMP.

A simple hand-feed for arc lamps is given below. At C C are the carbons. P P' are standards. I have large ones so as to hold large carbons. S S are brass supports, which I use to hold base above



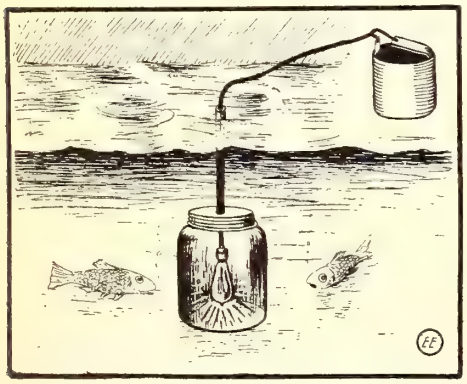
Efficient Hand-feed Arc Lamp.

table J. S' is a spring used to hold back P', which is soldered in detector cup D, which slides in a brass slide about 3½ inches long. B is 4 inches of threaded brass rod which screws through support W, which has a threaded hole in it. K is a typewriter knob. The base is 11 by 5 inches and is of wood or slate. The wire to carry the current can be fastened in same place as the carbons are, or can be held by separate binding posts placed on the base. I hope that this contribution will be of some use to the readers of *The Electrical Experimenter*. Contributed by

EDWARD RHOADES.

AN ELECTRIC LURE FOR FISH.

Every good fisherman knows that a light will attract fish. A simple light can be made by taking a pint fruit jar, cutting a ¼-in. hole in the top of the cover, inserting a piece of gas pipe in the hole and soldering it to the cover. Insulated wires are run through the pipe, and a small electric globe is attached to the ends in the



Luring Fish by Electric Lamp in Bottle.

jar. The other ends of the wires are attached to a pocket battery. The jar is placed under water and the light turned on, which attracts the fish.

SECOND PRIZE $2.00.

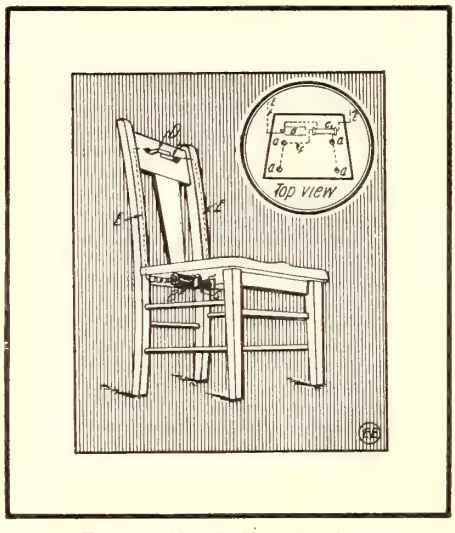
AN ELECTRIC "GOAT" FOR LODGES.

I give herewith a sketch of an electrically charged chair, and below, a brief outline of method of setting up same.

This chair will afford unlimited amusement in your office and probably rid it of a few chair warmers, and for lodge "initiations" it is the boss stunt.

Drive four small wire brads (a) into the under side of chair seat, letting just the points appear on the upper side of seat. With a fine nail set drive them back so that they remain just below the surface.

Fasten a small induction coil (c), and a battery (b) under the seat, soldering the secondary wires (f) to the ends of the brads (a). The parts of the switch (d) can be made from small strips of brass or



An Electric "Goat" Chair for Lodges.

copper, and screwed to the back of chair, as shown. The switch can be covered up by fake upholstery, etc.

Run the wires (e) down the back of chair to coil and battery, keeping them out of sight as much as possible. The switch (d) is concealed by a pad or drape of some kind thrown over the back of the chair, as aforementioned and the chair is ready for the first victim. When said victim leans back against the switch (d), closing the battery circuit with the coil (c), the *fireworks* begin. The coil may be a ¼ to ½-inch spark coil, and it is well to cover over the bottom and legs of the chair with cloth, etc. Contributed by

C. F. CONANT.

RECIPES FOR ERASING FLUID AND CLEANING FILES.

For obliterating ordinary script, prepare a solution of chlorine gas in water. Take a freshly written copy and wash repeatedly with this solution and then with some lime water. This will neutralize any acid which may be left.

The following suggestion may be useful to those making use of steel files:

Thoroughly clean the file from any grease, oil, alkali, soda or potash and dip it into a solution of 1 part nitric acid, 3 parts sulphuric acid, 7 parts water, by weight, for from five seconds to five minutes. Then wash in hot water; dip in lime water and oil to prevent rusting.

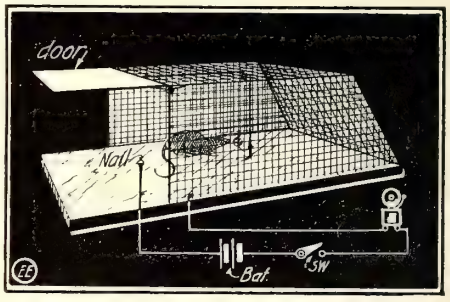
Contributed by G. J. ENGLESTEAD.

THIRD PRIZE $1.00.

AN ELECTRIC MOUSE TRAP ALARM.

The diagram herewith given depicts a novel little *mouse trap alarm* attachment.

Near the "trap" door is driven a nail so that when the door of the trap shuts it



Mouse Trap Alarm.

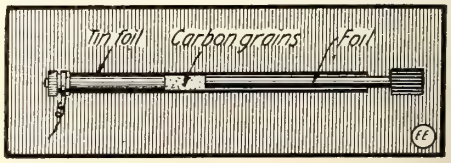
will touch the nail firmly. Two wires are fastened, one on the nail and the other to the trap, and connected up, as shown in diagram. When Mr. Mouse enters and attacks the cheese, the door closes, which causes the current to flow and rings the bell.

Of course this alarm is not always necessary, but those wishing a mouse trap alarm for traps located at a distance will find this most useful.

Contributed by BERNARD COHEN.

A POCKET-SIZE BATTERY RHEOSTAT.

A pocket regulator for battery currents is made from a piece of small glass tubing,



Simple Pocket Size Rheostat.

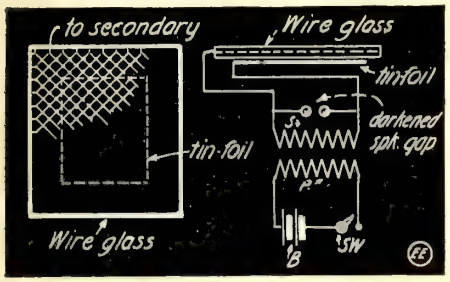
carbon grains, a match, tinfoil and a knob.

The match is fastened into the knob and covered with tinfoil, so that it will slide loosely in the tube. Stop the other end with tinfoil and fill in the ⅛-inch space with carbon grains. To regulate this move the match in and out.

Contributed by J. H. WILSON.

AN INTERESTING EXPERIMENT WITH "WIRED GLASS."

What might be termed "an interesting and peculiar spark effect" can be carried out by procuring a piece of window glass, with chicken wire made into it, commonly used in factory windows and doors. Now shellac one side of the glass and place a sheet of tinfoil on it having a smaller area than the glass. Before placing the tinfoil



"Wired Glass" Gives Spectacular Spark Effects.

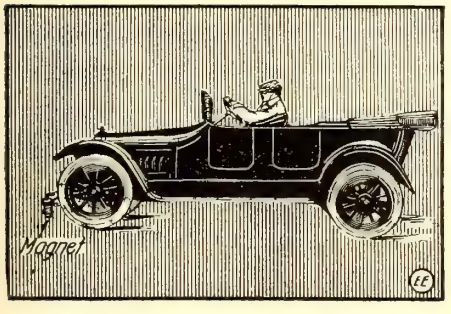
on, paint it black, and this face shall be toward the glass. Break off all the wires around the edge of the glass except one, and this is used for one connection as shown. Now, by connecting a 1-inch or, still better, a 2-inch coil to this glass arrangement and darkening the spark gap of the coil in a paper or wooden box, and taking the whole in a dark room, a most wonderful phenomenon will be noticed. When the current is turned on the glass will all light up with a violet hue in the form of the wire and little bubbles in the glass will become fluorescent, each in a different color, probably due to gas formed when the wire was plunged into the molten glass.

Contributed by

JOHN SEDGWICK.

SO YOU WON'T HAVE TO "GET OUT AND GET UNDER."

Have you ever leaned back among the cushioned comfortableness of your motor car on a scorching hot day, when your car went spinning along wafting delightful and fragrantly cool breezes to you, and blessed the wonderful invention of this means of refreshment? when bang! would come a loud report and the blissful trend of thoughts would be broken, your ease disturbed to the extent that you would vexatiously have to "get out and get under" to fix that "tiresome" tire. But at last has been found a remedy which will obliterate the thoughts which usually give vent to profane expression, significant of a punctured tire.



Magnets on Autos Pick up Tacks and Nails.

This aid has come in the form of a powerful electro-magnet, which may be attached in the front of the wheel or wheels of any *tired* vehicle, as illustrated herewith. Any steel or iron particles, such as nails, tacks, etc., lying along the road will be picked up by this magnet, and thus prevent a puncture. If a truck or automobile is to be used a magnet may also be adjusted to the rear wheel, so as to protect the rear tires from such mishaps as aforementioned, and this will be found very serviceable should it become necessary to back the vehicle up.

Sketch is herewith shown as to how the magnet is applied. This device is very practical, and at the end of a long ride or trip, if the rider or driver will examine his magnets, he will realize how many times his tires were endangered, but thanks to my invention, saved! Contributed by

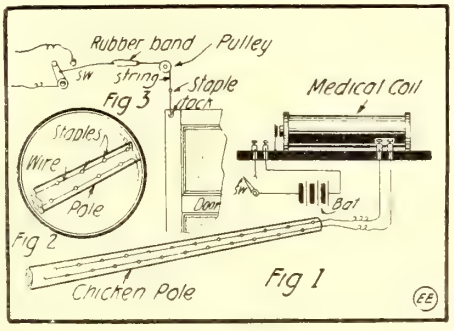
HARRY S. PAINE.

"SOME" CHICKEN THIEF ALARM.

I herewith give a suggestion which I am sure will remedy and comply with all demands of the suburban districts where the theft of poultry from the chicken houses is exercised without detection.

Procure a medical or spark coil, a few dry cells, a tack, some bare copper wire, insulated wire, a switch and a few staples.

We will first consider the pole on which the chickens rest at night. Cut two single pieces from the bare copper wire a few inches longer than the pole, and by means of small staples tack the wires about ½ inch apart along the entire length of the pole as shown in Fig. 1. (Fig. 2 gives a top view of the pole showing how wires, etc., are arranged.) Then place the coil in a corner and, after removing both electrodes from the binding posts on the side of coil, connect one insulated wire and



Electric Chicken-Thief Alarm.

lead it to one of the bare wire ends, as shown protruding from the chicken pole. By means of tape, insulate the connections well. The other connections may be made by following the diagram, which is self-explanatory.

The switching mechanism of the device is now constructed. Although very simple, it controls the entire operation of the instrument.

Drive a tack in at the top of your door. Procure a string about 6 feet long and in the center of it fasten a rubber band as shown. Fasten the string to the tack on the door, drive a small staple about 2 inches above and pass cord over a pulley to the switch handle as illustrated. Connect one point of the switch to one of the wires from the battery, and the handle of switch to one post on coil. The instrument is now completed and ready for operation.

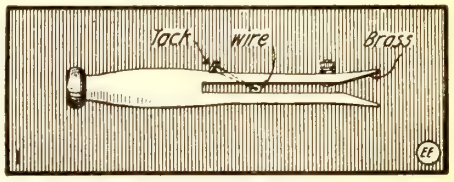
As soon as the intruder opens the door the string pulls the switch handle over to the switch point, both of which are in circuit, and naturally the coil is actuated. This sends a high-tension current through the bare wires on the pole and the chickens clutching it receive a "shock" and leap or fly about, cackling, and otherwise venting their disapproval. This will arouse the owner, and the unwelcome visitor will be welcomed in a manner that he (the owner) sees fit. Contributed by

WILLIAM WARNECKE, JR.

A HOME-MADE WIRE TESTER.

Many times there is a hurried demand for a reliable and sure wire tester to test some wire efficiently. The following is almost one of the simplest conceivable. Articles necessary are: A common clothes pin, a sharp-pointed nail or carpet tack, a binding post, some very small tacks and a sheet of brass or metal.

First cut out a thin brass strip the exact length of one of the jaws of the clothes pin and fasten it on by some very small



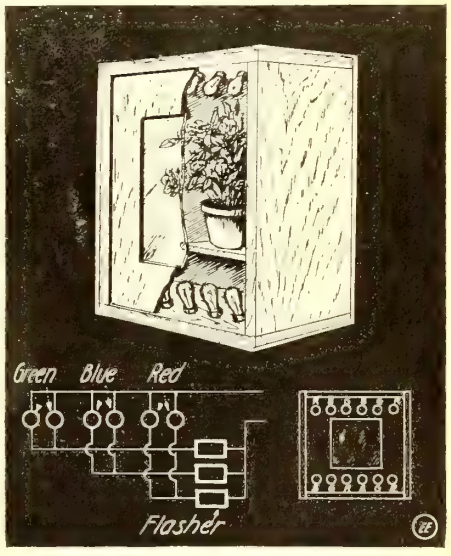
Test Clip Made From Clothes Pin.

tacks. (The heavy line in the drawing denotes the strip of brass.) Fasten it on either one of the jaws of your pin and also attach a binding post as shown. Now drive a sharp-pointed nail or tack about 1½ inches above the binding post and your tester is complete. It works as follows: Presume that you wish to test some insulated wire. You push the tester into the wire so that it is firmly gripped by the jaws of the tester. It is just the same as if the wire to be tested was a clothes line and you were hanging up wash by the use of clothes pins. The sharp-pointed nail or tack pierces the insulation on the wire until it has the bare copper wire thoroughly in its grip. There's where the excellent connection comes in, and although the clothes pin, in fact, the whole device, looks so odd and simple, yet it cannot be overestimated in its various uses.

Contributed by HENRY BROWN.

COLORED LAMPS IN WINDOW DISPLAY.

One of the most attractive window displays can be made by using colored lamps connected to flashers, giving an illumination variable in color. The advantage of this effect is that it has an almost universal application. Any kind of goods can be shown to advantage.



Ever-Changing Colored Lamps Give Beautiful Window Display.

A box with an opening in front as indicated is painted a dead black inside and the back is lined with black velvet. Red, green and blue lamps are used as shown, the wir-

ing being very simple. The lamps being shielded from the observer and the inside of the box being black, the goods exhibited appear to undergo mysterious changes in color.

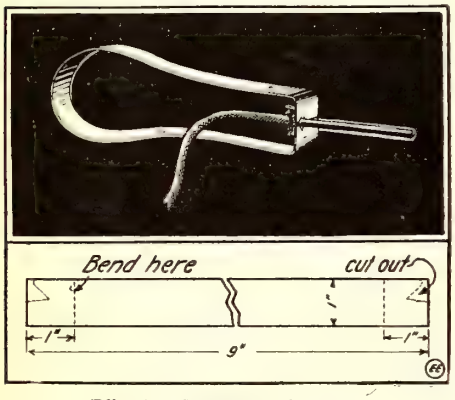
The number of lamps to be used depends upon the size of the box, and likewise upon the surroundings. Twice as many blue lamps should be used, for their intensity is lower than the green or red lamps. If the lamps are 60 watt Mazda, the number of lamps shown in the illustration will be sufficient to display in a box with an opening 20 inches square. The more lamps used, however, the more striking is the effect.

This sort of window display should be of service to the florist who is intending to advertise his flowers. The flashers can be of the thermostat type, which operate automatically and are very cheap to purchase. The best method of switching on the various colored lamps successively, however, would be by means of a small motor-driven flasher with rotating metal segments and brushes in the place of the thermostatic flashers mentioned. With a little ingenuity on the reader's part such a commutator flasher arrangement can be easily improvised. Contributed by

A. FLORIA.

A WIRE INSULATION REMOVER.

To scrape the insulation off wire with a knife blade or pliers is a very slow and tiresome job, as every experimenter knows. In order to make this work easier, the following directions may be employed:



Effective Insulation Scraper.

Procure a piece of spring steel about 9 inches long and 1 inch wide (a heavy clock or phonograph spring will serve the purpose), and with a file make a V-shaped notch in each end, as shown in the drawing. One side of the notch should be made a little shorter than the other, so that the wire can the more easily be inserted. Now bend over carefully the ends at the dotted lines as illustrated, because spring steel when cold is very apt to break. It is a good idea to heat the spring where it is to be bent, over a bunsen burner, so as to insure its flexibility. The notches should then be sharply ground and the scraper shaped as sketch shows. The scraper is used by inserting the wire in the notch, pressing the sides together with the hand and drawing the wire through.

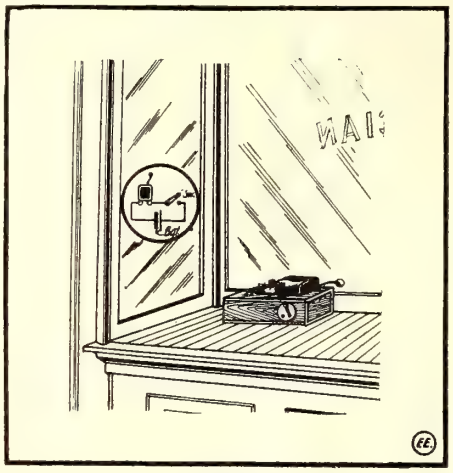
Contributed by

FRANK J. L. HAVERLAND, JR.

AN ELECTRIC WINDOW TAPPER.

This little device can also be termed a "show window attractor," and is commonly used in electrical and other stores. To construct, the following directions will be serviceable:

A box 8 inches long by 3½ by 4 inches, with a hinged cover, is necessary. Mount on the cover with screws, a common electric bell, minus the gong. A switch is fastened on side or top of box. A 3-volt "Radio" dry cell is preferable, as this eliminates the bulk of other batteries, giving only 1½ volts. A diagram of the wiring is given herewith. The bell should be



Window Tapper Made From Ordinary Bell and Battery.

mounted about 1 inch over the cover from the edge, and the best effects are obtained by placing the box in a corner of the store window and bending the hammer of the bell to give the proper adjustment to the window pane.

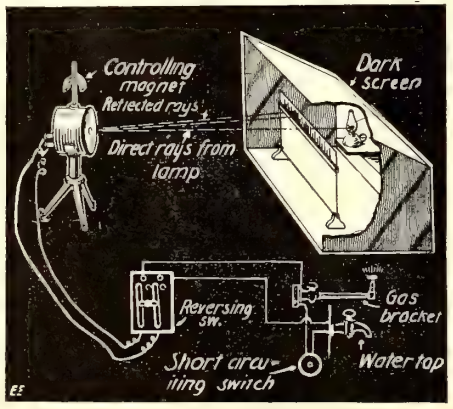
The bell will work intermittently or constantly, as desired, and the hammer vibrating against the glass of the store window produces an ear-shattering noise, which naturally attracts the inquisitive passer-by. Contributed by

W. R. WELLS.

DETECTING ELECTRIC CURRENT BETWEEN WATER AND GAS PIPES.

Those having a sensitive galvanometer at hand will find it interesting to conduct experiments to see if they can detect any electrical potential differences between the gas and water pipes in their house or laboratories. In some cases this amounts to a considerable voltage.

The sketch herewith shows how a reflecting galvanometer is arranged with a scale and a lamp which throws a beam of light through the small hole in the scale proper. This beam of light strikes the small mirror in the reflecting galvanometer and reads across the scale by reflection, according to the magnitude of the current passing through the galvanometer windings or coils.



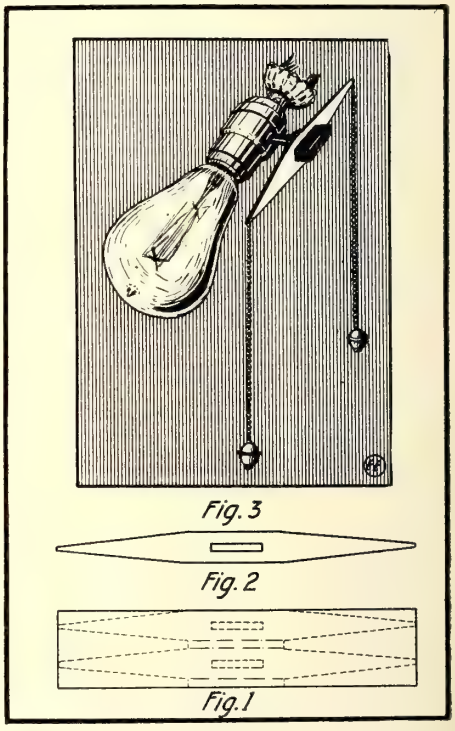
Detecting Stray Earth Currents.

An English experimenter recently stated that he had measured considerable electrical current potentials existing between water and gas pipes in his house and in some cases he detected 1/60 of a volt. He also very ingeniously arranged a method of telegraphic signaling with a friend residing about ¼ mile away from his house. This signaling was carried out by having his galvanometer connected across the gas and water pipes and his friend simply arranged a Morse key or push button across the gas and water pipes in his laboratory ¼ mile away.

This experiment is very interesting and it hardly seems possible that such an arrangement would work over distances of ¼ mile, but it is a matter of fact that it has worked, and further experimenting along this line would seem indeed worth while.

A CHAIN PULL FOR KEY SOCKETS.

Here is a valuable idea which your readers can use successfully on any socket key of their electric lighting system. Only a piece of stiff metal and a gilt chain or cord is necessary. Mark out (see Fig. 1) and then cut around the dotted lines made. Fold over and put on finishing touches as illustrated in Fig. 2. Then slip the novelty into your key of socket and it will work simply, easily and reliably. It has the "chain pull" effect, and you will find if you make *one* that you will make more and more until there is one on every socket key.



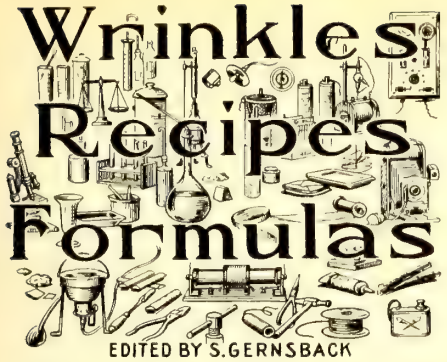
Chain Pull Attachment for Key Sockets.

Contributed by

FRED WARNER.

INLAND WEATHER FORECASTS BY WIRELESS.

The distribution of marine weather forecasts and warnings by radio-telegraphy is well known, but the use of this method of conveying weather information to inland dwellers is about to be tried for the first time in this country. Arrangements have been made to send out a wireless forecast daily, between 12.45 and 1 p. m., from Illiopolis, Ill., to all receiving stations within a radius of 125 miles. The messages will be sent slowly (10 to 12 words a minute) for the accommodation of amateur operators who are not sufficiently expert to receive faster.



Under this heading we will publish every month useful information in Mechanics, Electricity and Chemistry. We shall be pleased, of course, to have our readers send us any recipes, formulas, wrinkles, new ideas, etc., useful to the experimenter, which will be duly paid for, upon publication, if acceptable.

EXPERIMENTERS APHORISMS.

In the following, we wish to give to the Experimenter some hints as to the use of the different ingredients and how to work them:

(1) Always bear in mind that exact working of a formula requires ACCURACY, CLEANLINESS, PATIENCE, and SKILL.

(2) Know what you are about, before you start to experiment.

(3) "THE HISTORY OF FAILURES IS THE HISTORY OF SUCCESS" goes an old adage, and it applies well to the experimenter.

(4) Many times impure, wrong or deteriorated raw materials, spell FAILURE instead of SUCCESS.

(5) A great many of the chemicals and ingredients required, cannot be obtained from drug stores; buy them at a reputable supply house.

(6) BEFORE CONDEMNING A FORMULA, be sure the fault does not lie with the manner of handling it, or the purity of the ingredients.

(7) Be sure to mix the materials comprising a certain formula in the proper sequence.

(8) When starting to prepare a mixture, especially one containing liquids, ask yourself: "IS THE SPECIFIC GRAVITY CORRECT, AS INDICATED BY A HYDROMETER? IS THE TEMPERATURE RIGHT? IS THE QUANTITY OR WEIGHT RIGHT?

(9) Acids and water, when mixed, should be manipulated in the proper manner, i. e., THE ACID SHOULD BE POURED INTO THE WATER, and not vice versa, as the solution is liable to be forcibly ejected from the containing vessel and into the mixer's face.

(10) For any kind of SYSTEMATIC WORK, a floating THERMOMETER and HYDROMETER, as well as measuring glasses and scales, should always be provided, as GUESSWORK is EXPENSIVE, and SOMETIMES FATAL.

(11) Put labels on ALL bottles, boxes and packages with FULL INSCRIPTION as to their contents, it will avoid troubles and mistakes.

(12) Remember that a beginner cannot expect to make articles AT FIRST, which will compare with regular manufactured products.

FORMULA NO. 14.
BLUINGS FOR METALS.

Blue Finish.—Clean the article very carefully. Make a mixture of 1 part of *Nitric Acid*, 10 parts of *Water*. Apply the liquid with a sponge until a blue film is produced. Wash with warm water; dry with a flannel and wipe with *Linseed Oil*.

Bluing Brass Like Steel.—Take a leaden vessel, put in some *Hydrochloric Acid* and very little of *Arsenic Acid*. The brass article is laid in this vessel and soon assumes iridescent tints. Remove when the desired shade is obtained; wash with water and dry.

Bluing Gun Barrels.—Dissolve 4½ oz. of *Hyposulphite of Soda* in 1 qt. of *Water*. Also dissolve 1¼ oz. of *Acetate of Lead* in 1 qt. of *Water*. Mix the two solutions and bring to a boil in a stone pot. After having thoroughly cleaned the barrel, coat with the hot solution, using a piece of sponge tied to a stick of wood. When color develops, wash with water, dry with a piece of flannel and finish with *Boiled Linseed Oil*.

Oxidizing Silver.—Boil the article in a mixture of 5 oz. of *Bromine*, 120 grains of *Bromide of Potassium*, 10 oz. of *Water*, in an earthenware pot for three to five minutes. Remove, dry and polish.

Bluing of Steel.—Heat the steel over a flame of alcohol and varnish with a mixture of *Prussian Blue* and *Alcoholic Shellac Varnish*. Use a thin varnish. Of course this is only an imitation of bluing, and the article has to be lacquered to make it wear.

Real Bluing of Steel.—This formula is used to blue revolver parts, vibrators, steel knives, etc. Mix carefully together 25 parts of *Trichloride of Antimony*, 25 parts of *Fuming Nitric Acid*, 50 parts of *Hydrochloric Acid*. Tie a rag to a stick and apply the mixture freely. After rubbing the article with a flannel it may be polished on a polishing head with a green oak wheel until an even, clear blue is obtained.

Revolver Barrel Bluing.—Clean the barrel with emery cloth; remove all grease with lime and polish the surfaces. Take fine and clean wood ashes in a muffle, put the barrel in the middle and heat the muffle to a temperature of *cherry red*. With a pair of tongs, remove the article from time to time to see if a dark blue can be obtained when cooled in the air. When the desired color is obtained take the barrel out and let it cool in THE AIR. Finish with *Boiled Oil* and polish.

Bluing Steel.—A very simple process is the following: Melt *Saltpeter* in an iron pot. Clean and polish the steel article and dip in the saltpeter until sufficiently blued. Remove and cool at once in *Paraffine Oil*. Wipe with a flannel rag and dry in sawdust.

Bluing Silver.—The oxidizing of silver is produced by placing the articles in a solution of *Liver of Sulphur*, diluted with *Spirits of Sal Ammoniac*. Allow to remain until the desired dark blue-black tone is produced; then wash in water, dry and polish.

Durable Blue on Iron and Steel without Heat.—Take a stone pot and mix together 1 part of a ½-% solution of *Red Prussiate of Potash*, 1 part of a ½-% solution of *Ferric Chloride*. Dip the articles until the desired effect is produced. When dry, the articles may be lacquered. S. G.

SYMPATHETIC INKS.

I give below the formulæ for making sympathetic inks:

Formula No. 1.

Take some pure lime juice, or lemon will do, and write with it on a paper. Then heat over an alcohol lamp and the writing will come out brown.

Formula No. 2.

Dissolve some sulphate of iron in water and write with it. Heat and the writing will come out dark brown or black.

Formula No. 3.

Dissolve some chlorate of potash in water. Write with it and heat. The writing will come out brown.

Formula No. 4.

For purple invisible ink. Take some salicylate of soda and dissolve in water; don't make the solution too strong, or it will turn brown where you write with it. Reagent. About 50 per cent. solution of tincture of iron applied with a brush. The writing will come out purple.

Contributed by ELLISON FRAZER.

Aluminum Lacquer.—For aluminum dissolve 100 parts *Gum Lac* in 300 parts *Ammonia*, heating for one hour over a *Water* bath, paint the thoroughly cleaned aluminum with the varnish and heat it to about 570 degrees Fahrenheit.

Polish for Varnishing Wood.—Shake well together 1 pint *Vinegar*, 1 oz. *Alcohol*, 1 pint *Linseed Oil*, 1 oz. *Butter of Antimony*.

INTERESTING EXPERIMENTS FOR THE AMATEUR CHEMIST.

The following experiments can be performed with household chemicals:

If you possess a battery giving from 4 to 20 volts you can perform the following experiment, which is particularly interesting on account of the variation of results, with apparently the same conditions:

Immerse two pieces of brass in a strong solution of common salt or sal-ammoniac and water. Connect one piece to the positive wire and the other to the negative, taking care that the brass pieces do not touch each other.

After the current has passed for one or two minutes the solution will become colored, and if the process is continued a colored pigment will be precipitated. The color of the precipitant varies considerably and may be either red, purple, green, blue, orange and possibly others, depending on the strength of the current and the composition of the brass.

The Grand Rapids can be made as follows: Fill a tumbler or test tube with water, throw upon its surface a few fragments or thin shavings of camphor gum and they will instantly begin to move and acquire a motion both progressive and rotary, which will continue for a considerable period of time. If the water be touched by any greasy substance the floating particles will reverse their course and dart back and, as if by a stroke of magic, be instantly deprived of their motion and vivacity.

A Rival to Jack Frost is produced by dissolving camphor gum in warm spirits until the spirits will dissolve no more; pour some of the solution into a cold test tube or tumbler and the camphor will instantly crystallize in beautiful forms like trees and landscapes.

This next experiment sounds as if it were "bigger," but it is not. Dissolve 150 parts of hyposulphite of soda in 15 parts of water and pour the solution slowly into a test tube or tumbler which has been heated in boiling water; fill the same about one-half full. Dissolve in another glass 100 parts of acetate of soda in 15 parts of boiling water. Pour this solution slowly on the top of the first in such a way that it forms an upper layer, without mixing the solutions. The two solutions are then covered over with a thin layer of boiling water and allowed to cool. Lower into the test tube a wire, at the extremity of which is fixed a small crystal of hyposulphite of soda. The crystal traverses the solution of acetate without causing trouble, but crystallization will immediately set in as soon as it touches the lower hyposulphite of soda solution. When the hyposulphite of soda solution becomes crystallized, lower in the upper solution a crystal of acetate of soda suspended by another wire and this will crystallize the same as the other solution. Contributed by

HAROLD B. FINKELSTEIN.

ANENT MAKING ELECTROTYPES.

I notice in the August last number of the *Electrical Experimenter*, page 160, an article on "Making Small Electrotypes," which, although excellent in its way, is capable of much improvement.

Mr. Sutton says, "*Three* cells of battery should be connected in series to do the plating." This seems not only absurd, but wasteful. One gravity (Zn-Cu-Cu. SO_4) is all that is needed. The writer has made many electros (beginning in 1861) and never used more than an E.M.F. of one volt.

Contributed by an "Old Experimenter,"

A. GALPIN.

WITH THE AMATEURS

AMATEUR RADIO STATION CONTEST.

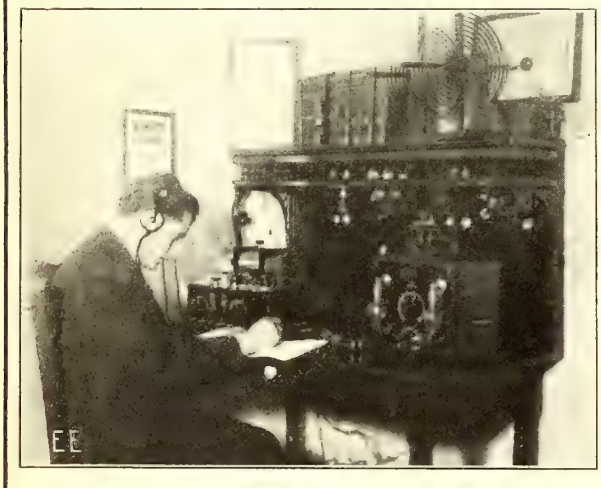
Monthly Prize, $3.00.

This month's prize winner.

AN EFFICIENT EXPERIMENTAL STATION.

I present a picture of my wireless station which I should like to have appear in your Radio Station contest. The instruments, which are of my own make and design, have produced very satisfactory results. The receiving set comprises a loose coupler, two variable condensers, a fixed condenser, loading coil, galena and perikon detectors, high-pitch buzzer and 2,800 ohms head 'phones, mounted in a hard rubber box which measures 12x12x 4½ inches.

On the right of the picture can be clearly seen an audion detector set with two Hudson filament bulbs, which can be also used as an amplifier. The front of the box is made of hard rubber and measures 11x10x 8 inches. In addition to this set, a variometer is employed which increases the sensitiveness of incoming signals. I hear



Prize Station of Louis A. Kaplan.

NAR, Key West, NAX, Colon, and a number of long distance stations.

My aerial is 45 feet long, 40 feet high and consists of four No. 14 copper wires spread 2 feet apart. My transmitting set is composed of a ¼-kw. transformer, oscillation transformer, stationary and rotary spark gaps, glass plate condenser and a heavy sending key. Owing to a low aerial, my sending range does not extend very far, but I am heard clearly up to 20 and 30 miles.

LOUIS ARNOLD KAPLAN.

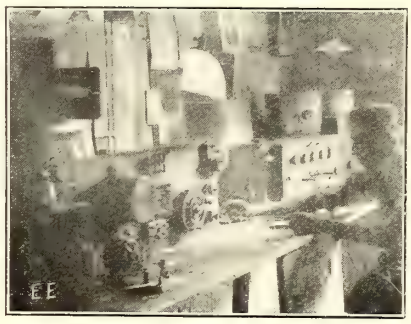
Bronx, N. Y.

AMATEUR WIRELESS STATION OF C. W. WATKINS.

Herewith I present photo which depicts my radio station and which I hope will appear in the radio station contest columns of your valuable magazine.

For sending I use a 1¼ K. W. transformer, oscillation transformer, aerial loading inductance, rotary and quenched gaps, condenser, hot wire ammeter, relay key, sending key and aerial switch. With this transmitting set I have been heard up to 200 miles; as far as Youngstown, O.

My receiving set, which was devised ex-



C. E. Watkin's Station.

clusively by Prof. M. E. Packman, of Dodge's School of Wireless, consists of a loose coupler, loading coil, variable and fixed condenser, two galena detectors and phones. Opposite the receiving set can be seen a large loose coupler, which is employed for long wave lengths and which can tune up to 10,000 meters. Mounted above the latter outfit is a wave meter built by Prof. Packman and myself, composed of variable condenser, inductance, buzzer, lamp and detector.

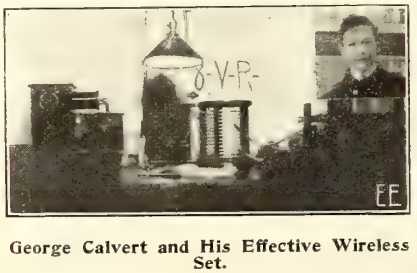
My aerials, of which I have three, constitute, respectively, a flat top 81 feet high at one end, 60 feet at the other by 94 feet long, and umbrella composed of eight wires and a one-wire aerial.

After four years of experimenting I can now obtain very satisfactory results with this station and can hear "N. A. A.," "W. S. L.," "N. A. R.," as well as other stations very well. My call is "9DI," and I would be pleased to communicate with anyone within my range.

Ashland, Ky. C. E. WATKINS.

GEORGE C. CALVERT'S WIRELESS SET.

I herewith submit a picture of my radio set for the Amateur Wireless Station contest. My aerial is made of No. 14 copper



George Calvert and His Effective Wireless Set.

wire, 200 feet long, 75 feet high, on spreaders 5 feet wide.

My transmitting set comprises the following: a ¾-kw. transformer, glass plate condenser, rotary gap (10,000 R.P.M.), with helix, hot wire meter and anchor gap. For receiving I use a loading coil, loose coupler, two variable condensers, a fixed condenser, audion and mineral detectors. The necessary switches are mounted on a panel.

When 2,000 ohm head 'phones are used I am able to hear "N. A. A." and "N. A. R." However, my 'phones are only wound to 1,000 ohms. My call is "8 V R" and I would like to arrange tests with anyone within my range.

I have read the *Electrical Experimenter* since it started and enjoy it very much.

GEORGE C. CALVERT.

Pittsburgh, Pa

RADIO STATION OF W. MORRISH.

The photograph I submit herewith shows my Canadian wireless experimental station which I used at Gravenhurst, Ont., Canada.

This station performed very good service all around in both transmitting and receiving, and I hope shortly to send you photograph of my new radio station in England.

As may be seen from the photo, the transmitting set comprised the usual helix, a spark gap, "Auto" ignition coil, key and condenser. A specially arranged D. P.



William Morrish and His Canadian Station.

D. T. knife switch mounted on the center of the panel-board over the table switches the aerial and ground connections from transmitting to receiving, and vice-versa.

The receiving set included a home-made loading coil, which is seen mounted on the wall at the left, also a large size loose coupler with auxiliary tuning inductance, as well as variable condenser of the tubular type. Crystal detectors were employed as well as others.

W. MORRISH.

Mutley, Plymouth, England.

GREENFIELD, MASS., RADIO CLUB IS FORMED.

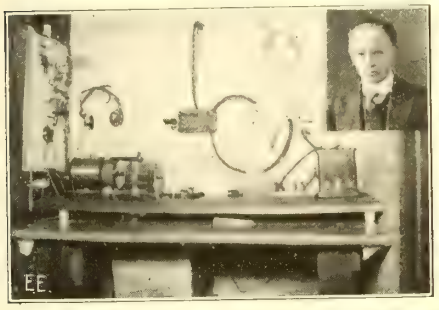
At a meeting held recently at the Postal Telegraph Cable Co.'s office, the manager of the company, Costas S. Theofan, brought about the organization of a wireless club in Greenfield, Mass., and it is named the Greenfield Radio Club. The club was formed with a membership of 15. The following officers were elected: President, Arthur Duchemin; vice-president, Howard S. Wing; secretary and treasurer, Costas S. Theofan. Communications from

amateurs within 20 miles from Greenfield are solicited by the club.

A few of the members are: Albert Karner, Rolland Stratton, Brenton E. Perry, Raymond Holden, Donald N. Dinsmore. The members of this club are mostly boys who are experimenting with wireless telegraphy. Albert Duchemin, of 26 Pond street, was the first of the local fellows to begin this line.

Radio Station of Marcus G. Limb.

Herewith is given photo of my wireless



Marcus G. Limb and His Radio Set.

outfit. My receiving set comprises a Murdock loose coupler, E. I. Co. variable and adjustable condensers, loading coil, universal and crystal detectors and transatlantic type 'phones. The two detectors are back of the receiving transformer. The following constitutes my transmitting set: A humming transformer, oscillation transformer, oil-immersed condenser, spark gap and a condenser in series with the ground to reduce the wave length.

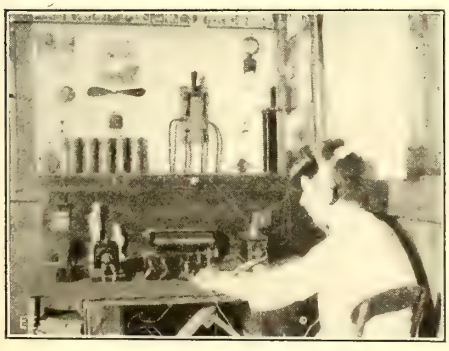
I can send about 25 miles and on favorable nights I can get N. A. R. My aerial is 85 feet long, 50 feet high and has six wires in it.

Wooster, O. MARCUS G. LIMB.

Doughty Radio Station.

The accompanying photograph depicts my radio station located at Fairhaven, N. J. My aerial is of the inverted "L" type and consists of four No. 12 copper jacketed wires, 150 feet in length, spaced 2½ feet apart. It is supported by an iron mast 75 feet high and the lower end is attached to a pole 45 feet high. The lead-in is 50 feet in length and is taken in at the back of the building through porcelain tubes. My ground wire is connected to a water pipe which is driven into moist ground at a depth of 12 feet.

For receiving I employ Brandes' 2,000-ohm receivers, Amco receiving transformer, silicon and galena detectors, fixed con-



Mr. Doughty's Wireless Outfit.

denser and two loading coils of my own construction.

My sending set consists of a 1-inch spark coil, condenser and zinc spark gap, which is mounted on top of my coil case.

JOSEPH H. DOUGHTY.

Greenwich, Conn.

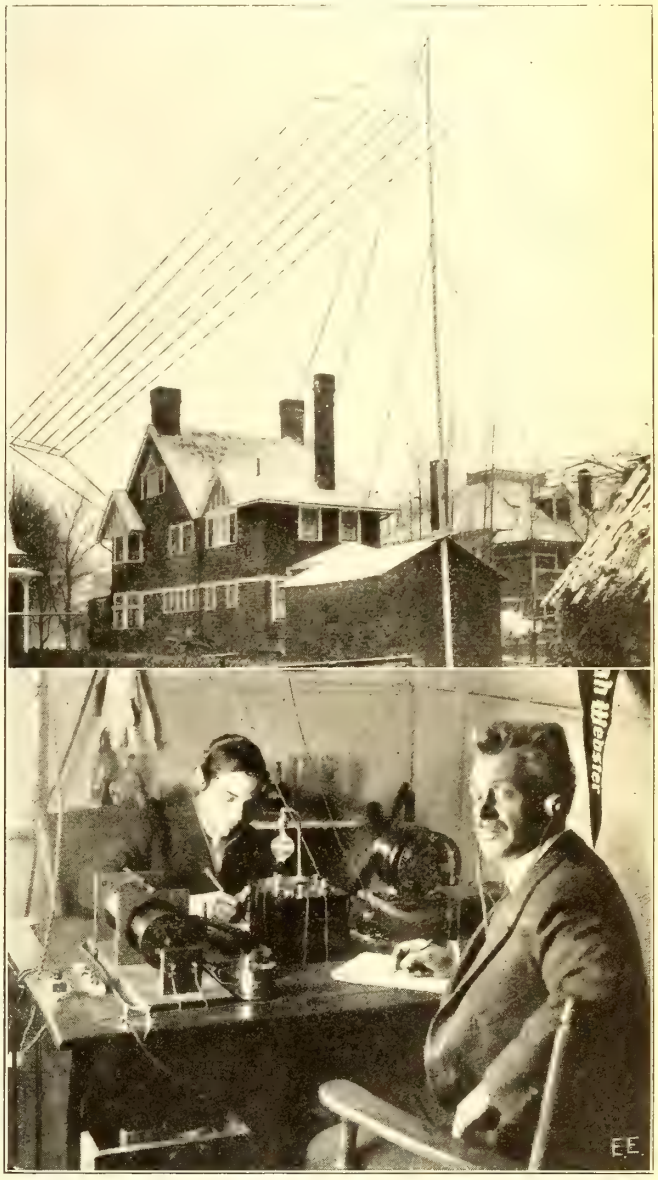
Radio Station of Famous Inventor

Herewith I submit photograph and description of my wireless experimental station.

The receiving station outfit consists of a large loose coupler by means of which I can get very accurate tuning, an Audion detector and variable condenser. The two sets of phones are usually connected in. The transmitting set consists of a 1 kw. specially made transformer, glass plate condenser, oscillation transformer, and a ¼ horsepower General Electric Co. motor running a specially built, quenched-rotary spark-gap. Two aerials are arranged, one for sending on 200 meter wave length for distances less than 10 miles, and one for sending on 425 meter wave length for distances in excess of 10 miles. Five plates of the condenser are used for the 200 meter wave length and 10 plates added to these five for the 425 meter wave length. The outdoor equipment consists of a 60 foot mast at one end and a 50 feet mast at the other, 100 feet apart. The spreaders are 10 feet long and have 11 wires of stranded copper between them. The ground connection is carefully soldered and connected to ground at three places. This station can "work" points in Southern New Jersey, Northern Massachusetts and can receive Colon, Panama and ships at sea, when two or three days out of New York. The station holds a special license for the purpose of relay work in the American Radio Relay League. The call letters are 1ZM.

HIRAM PERCY MAXIM.

Hartford, Conn.



Efficient Wireless Experimental Station and Aerial of Hiram Percy Maxim.

WIRELESS AT MASSACHUSETTS "TECH" CAMP.

Far down in Maine, where the morning newspapers of the great cities are not received till after nightfall, the students at the Massachusetts Institute of Technology surveying camp have the baseball scores and news items posted on the bulletin before breakfast. In fact, it would be possible to post these items at night before the presses of the city papers have begun their work of printing, but for the fact that the receipt is after camp hours at night and there would be no one astir to read the bulletins if posted when received. This touch with the world is because the students have wireless receivers that catch the news. Technology camp has its own post-office, Technology, and is located on Gardner Lake, East Machias, about eight miles by road from the village. It is a summer school which transfers the work of practical surveying and hydraulic measurement from the limited city areas to the woods and ponds where actual work can be done on the commercial scale. There are about 100 students in the camp and a score of professors, and the students have in commission two wireless receiving sets.

RADIO CLUBS ATTENTION!

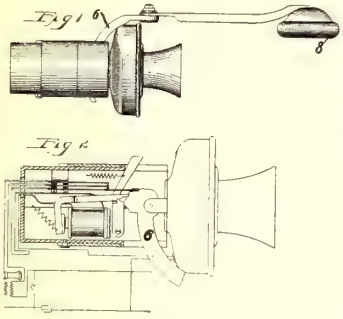
We are always pleased to hear from young Edisons and Radio Clubs. Send a write-up of your Club with photos of members and apparatus to-day to: Editor "Amateur Gossip" Section, The Electrical Experimenter, 233 Fulton St., New York City.

LATEST PATENTS

Automatic Telephone Switch.

(No. 1,145,632; issued to William C. Ude.)

An automatic telephone switch, so designed that the pressure of the ear against, say a watch case receiver 8, on a pivoted arm 6, will

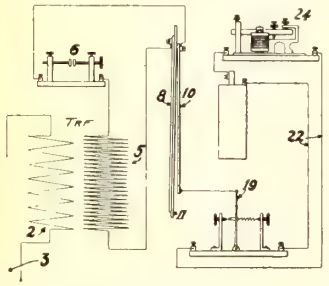


cause the switch springs, as perceived, to automatically control the cutting in and out of circuit of the telephone transmitter and receiver, instead of having to hang up the receiver in the usual way. A very good idea.

Wireless Receiver for Lighting Circuits.

No. 1,143,799; issued to Ross B. Avery.)

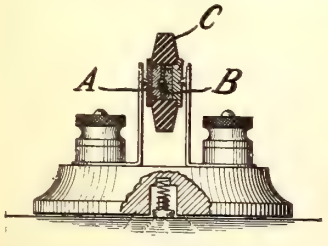
An ingenious wireless receptor, claimed to work on lighting lines by its inventor. The wires 3, connect with an ordinary alternating current



lighting or power circuit. The current then passes through primary 2 and secondary 5 of a step-up, high-potential transformer. The current from the secondary transverses the small spark gap 6 and charges an electro-static plate arrangement 8 and 10, separated by an insulating plate 11. Whenever a sufficient charge acts between the plates 8 and 10, the plate 10 is attracted and in its movement actuates a switch 19, which in turn closes a local sounder circuit 22. It is claimed by the inventor that this arrangement will work on A. C. circuits and in adjusting the device the spark gap 6, is so regulated that the ordinary current from the secondary 5 will not jump the gap. Then when any wireless waves superimpose on the A. C. circuit and reach the apparatus, they will boost the current sufficiently to jump the gap and thus actuate the sounder 24, as evident from the foregoing.

Improved Mineral Detector.

(No. 1,144,399; issued to Eugene T. Turney.)

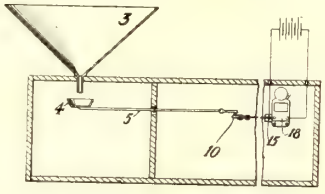


The well-known "Crystaloi" detector now for sale on the market for some time. It employs two electrodes A and B; the former having a piece of sensitive mineral, such as the best grade natural galena. The electrode B consists of a mass of finely divided conductive material, such as aluminum-bronze filings or they may be carbon grains, etc. These mineral electrode members are carried in a rotatable casing C; so that the detector is quickly readjusted, by simply turning the container on its axis, between two supporting springs, as perceived. Thus, a number of sensitive contact points are practically always available with this ingenious form of detector construction.

Electric Rain Signal.

(No. 1,143,246; issued to Joseph J. Barrash.)

A useful device where a rain signal is desirable. The rain is caught by the funnel 3 and passes through it into a catch pan 4, which overbalances the pivoted lever 5. When rain falls and actuates the lever, it releases a sliding catch 10, connected by a spring or otherwise to

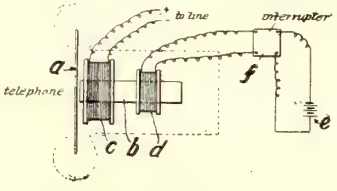


a spring switch 15, which closes the battery circuit for an electric alarm bell 18 or instead, this circuit may control an electric motor for closing windows or skylights.

Sound Enunciator.

(No. 1,145,554; issued to Francis W. H. Clay.)

The inventor of this sound enunciator arranges to have the diaphragm A kept in a constant state of high frequency vibration by using for instance, a superimposing magnetising coil D, containing in its exciting circuit a source of electric current E, and a very high-speed interrupter F. It is claimed that if the diaphragm A is thus maintained

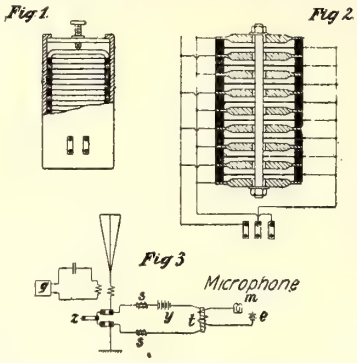


in a constant state of vibration, at a frequency above audibility, that the ordinary sound waves to be reproduced by the diaphragm from the telephone line coil C, in the usual way, will be much clearer and freer from distortion or false tones than in the usual way, where the diaphragm is allowed to vibrate by itself.

Condenser Transmitter for Radiotelephony.

(No. 1,148,827; issued to Walther Burstyn.)

A modification of the condenser transmitter, at one time used by Prof. Fessenden for radiotelephonic antenna current control. This patent covers a multiple disc condenser transmitter, as drawing shows. The dielectric spaces between the various metallic discs are varied and conjointly the electrical condenser capacity, by creating various degrees of electric charge on the plates, through a circuit SYT, made up of a battery, choke coils S S, and telephone induction coil T. The primary of this induction coil is hooked up with a microphone of the usual pattern M, and a battery E. The regular high frequency radiophonic current charges the antenna through

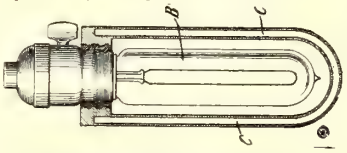


an oscillation transformer and the high frequency generator G. The condenser transmitter is shown at Z.

Heat-Shield for Incandescent Lamps.

(No. 1,145,837; issued to Edward Redmond Hoff.)

This invention relates to the provision of a glass vacuum chamber C around the regular incandescent lamp B'. The idea is to prevent excessive heat being projected from the lamp, especially when used in close proximity to a person reading, etc.

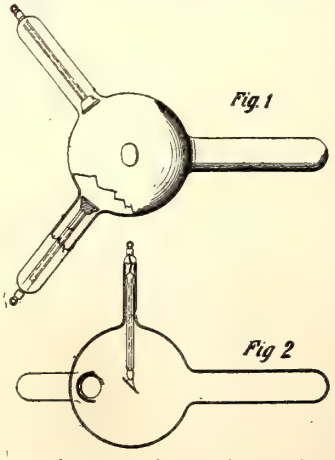


High-Frequency X-Ray Bulb.

(No. 1,147,125; issued to James E. Seeley).

This invention relates to a double cathode X-ray tube for use with alternating currents, irrespective of their method of production and especially with alternating high frequency currents.

The present invention consists fundamentally in the combination of a pair of cathodes and a single target, in such arrangement that both cathodes may focus on and bombard the target at a single focus point. This invention is effected by an arrangement of both cathodes on the same side of the plane of the impact face of the target; and the arrangement necessitates relatively angular positions of the cathode

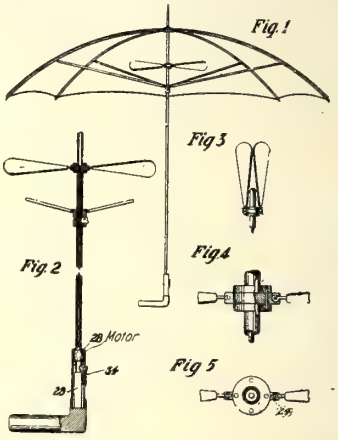


axes, these axes intersecting at the point of impact on the target, and also practically necessitates the placement of the target at an angle with the plane determined by the cathode axes. These features and others of more minor importance, accomplish the fundamental object of the invention; that object being to provide a tube capable of operating with alternating currents and having a single focus point on the target.

Electrical Umbrella Fan.

(No. 1,148,332; issued to Sylvester Onyskow, assignor one-half to Lubomir Dulikrovich.)

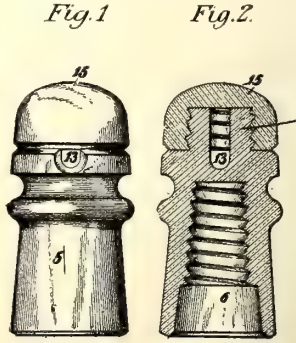
This invention covers the use of a small, electrically driven fan, as perceived and to be utilized in umbrellas. The fan blades are driven by a small shaft, passing upward through the umbrella handle and



stem, as is evident. This shaft connects with a miniature electric motor 28, which receives current from a small flashlight type battery 29, in the handle of the umbrella. A push button 34 controls the battery current to the motor. The expense in making up this arrangement and also considering the gross efficiency, and especially the small "breeze producing power" in this case, does not seem to warrant at all the expense in making up such an arrangement.

Electrical Insulator.

(No. 1,146,201; issued to Silvester Nunn.)



A new and simple form of insulator, intended to be made up of porcelain or glass. This insulator, so the inventor claims, is very efficacious for telegraph and telephone lines, especially; and the wire is not clamped in same, but is simply retained in the insulator in the slot 13. A threaded cap 15 screws down on a stud 11, forming part of the insulator base 5. Thus the wire once placed in the slot 13 cannot get out of same. The patentee claims that a long length of wire (even a mile or more) can be tightened up without touching any of the individual insulators along the line, due to this novel construction.

COPIES OF ANY OF THE ABOVE PATENTS SUPPLIED AT 10c. EACH.

Phoney Patents

Under this heading we will publish hereafter electrical or mechanical ideas which our clever inventors, for reasons best known to themselves, have as yet not patented. We furthermore announce the grand opening of the

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PHONEY PATENT OFFIZZ

PHONEY PATENT ALMOST AFFIRMED BY I. M. A. NUT

"No. √69512." **ELECTRO-MECHANICAL NURSE** **Applied to Feb. 37, 1926.**

Specifications Overlooked

TO those unconcerned and who care not, let it be known that I, myself, unassisted and alone, have invented a peculiar worthyful and valueish apparatus to alleviate and circumnavigate the multifarious troubles of the housewife.

This invention has the full sanction of Mr. Roosevelt in his great crusade against race suicide, and I feel that I am to be heralded as the Saviour of the race. 'Tis true that the canine included in the design is subject to more or less torture for the time being. However, I expect shortly to be able to improve on this detail.

The operation of this contrivance is as follows: The baby (1) wakes up and, not seeing its mother, starts to cry. (The mother no doubt is operating the wireless telephone, back-fence type.) The voices actuate the microphone (2), which is connected by wires (3-4) to the 'phones (5) clamped on the ears of the dog (6). The dog, naturally, knowing something is wrong, runs from his kennel (7), pulling out the sliding bar (8), to which he is fastened by means of the chain (9). This closes the switch (10), thus completing the circuits containing batteries (11), motors (12-13) and the electric phonograph (14).

The motor (12) rocks the cradle (15) by means of the arm (16) attached to an eccentric on the motor shaft.

Simultaneously motor (13) starts the double compound duplex air-cooled pump (18), to which it is connected by means of gearing (17). The pump forces air through pipe (20) into milk tank (19), which in turn forces the milk through pipe (21) and flexible tubing (22), thus supplying the baby with a stream of milk.

At (23) is shown the adjusting screw which regulates the delivery of the milk to the baby, and by this means it is possible to regulate the hose to give anything from a steady, forceful stream to a fine spray.

The phonograph (14) contains a record made by the mother of the child. A photograph of the mother (24) is placed in front of the phonograph, so in case the baby should look in the direction of the voice it will see the photograph and, thinking same is its mother, will instantly fall asleep.

A safety valve (25) is used to adjust the pressure in the milk reservoir.

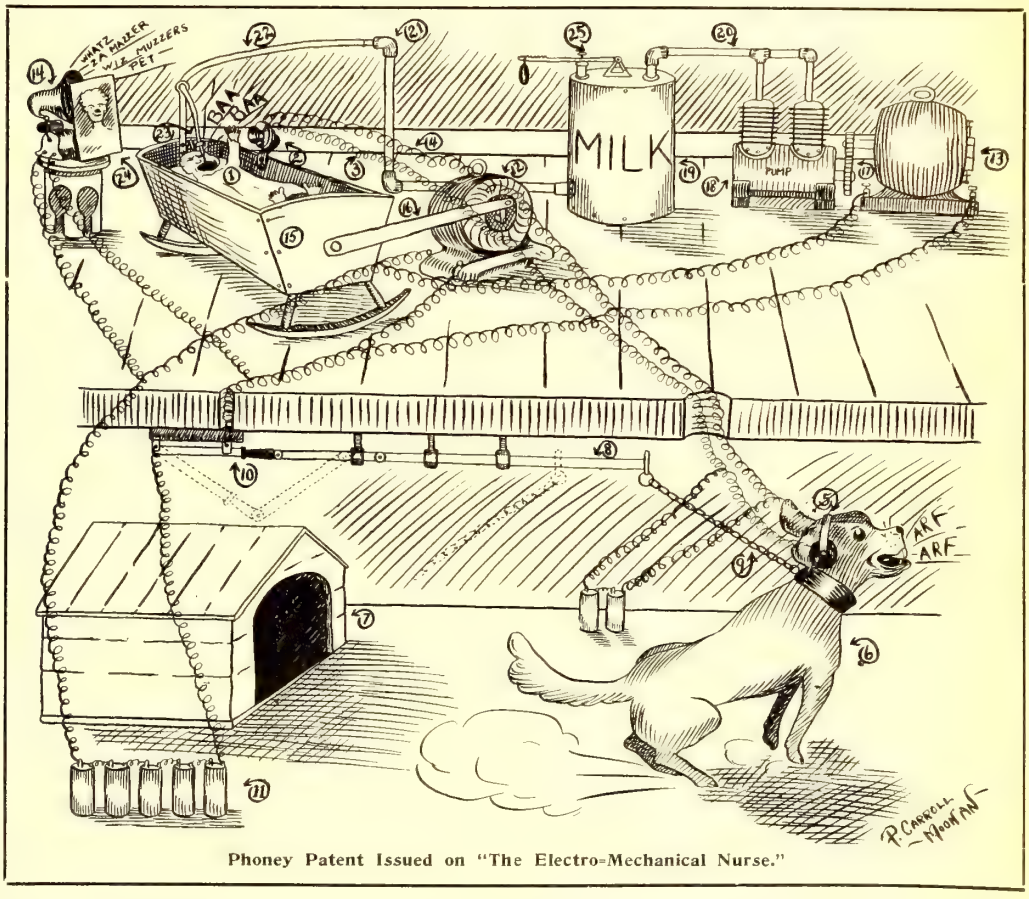
The dotted lines show the position of the switch before the dog leaves the kennel, and when the baby stops crying the dog goes back to the kennel and the switch opens again, thus saving milk and current.

All rights to this invention are retained, including foreign and domestic motion picture rights.

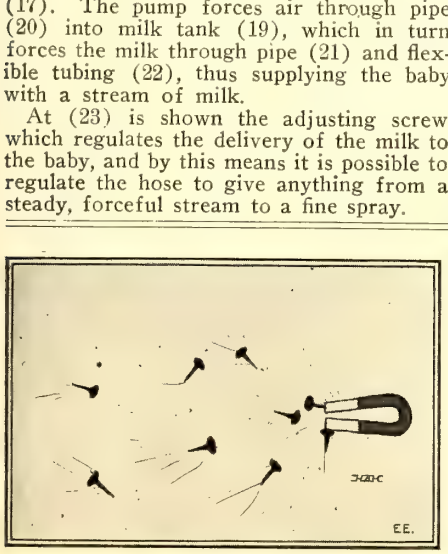
In testimony thereof I have riveted and soldered hereto my seal, this day, date unknown and unstated, in this slow old burg of Earthquakerdom. I. M. A. NUT.

By his Attorney,

Witnesses: *P. Carroll Moonan,*
G. O. Beatit, *Philadelphia, Pa.*
Ded Enburied, 2d.



Phoney Patent Issued on "The Electro-Mechanical Nurse."



"In-Come Tacks."

SOLUTION OF "PHONOGRAPH" CODE PUZZLE IN SEPTEMBER ISSUE.

This Way, Boys, to the Maze, Follow Me Around, Now Please Don't Get Dizzy, Soon We'll Be There. Ooh, Such a Headache!

BLAME GERMAN WIRELESS PLANT FOR RAIN OR DROUGHT.

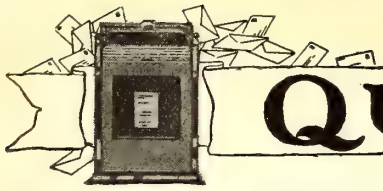
No matter what happens, the German wireless station at Sayville, L. I., is to blame, Sayville folk think. Last year, when there was a memorable drought, they said the electrical effects absorbed all the moisture and made Sayville dry as a Saratoga chip.

Now that the skies have bathed Sayville about every second day all summer, the German wireless station is again to blame.

AN ELECTRIC SQUIRREL?

A German who had not been in the country very long walked into a drug store one day. The first thing that caught his attention was an electric fan buzzing busily on the soda counter. He watched it with great interest for some time, then, turning to the clerk, he said:

"Py golly, dat's a lifely squirrel vot you got in dare, ain't it?"



QUESTION BOX

This department is for the sole benefit of the electrical experimenter. Questions will be answered here for the benefit of all, but only matter of sufficient interest will be published. Rules under which questions will be answered:

1. Only three questions can be submitted to be answered.
2. Only one side of sheet to be written on; matter must be typewritten or else written in ink, no penciled matter considered.
3. Sketches, diagrams, etc., must be on separate sheets. Questions addressed to this department cannot be answered by mail.

ENERGY EQUIVALENT OF 1/12 H.P. ENGINE.

(328.) F. Efermeyer, Cleveland, O., asks about the equivalent power or energy in foot pounds of a 1-12-horsepower engine.

A. 1. A 1-12-horsepower engine is capable of doing 2712.5 foot pounds of work per minute, thus it will lift that number of pounds one foot per minute, or another weight an equivalent height in that space of time.

ELECTRICALLY DRIVEN BICYCLE

(329.) Byron S. Human, Niagara Falls, N. Y., inquires about the practicability of utilizing a ⅛-horsepower battery motor for propelling a bicycle.

A. 1. This is quite impracticable. In the first place, ⅛ horsepower is insufficient to drive a bicycle and, furthermore, it requires an excessive weight of lead storage cells for any appreciable length of run with the proper horsepower.

Experiments are being carried on with motorcycles driven by electrical power, but so far nothing really practical has come of it.

WIRELESS QUESTIONS.

(330.) Wynn Boydan, Medina, O., asks several questions on radio matters.

A. 1. We cannot understand why the mere adjustment of a detector should necessitate such a great change in the inductance used in tuning.

You must have made some change in the capacity of your aerial to cause this marked effect, as detectors have little or no effect on the wave length.

Your suggestion for a new loose coupler is not exactly new and possesses no advantage over modern types. In winding the two coils so close you practically destroy all selectivity, which is the secret of the operation of the loose coupler. The plan will work, we admit, *and the coupler will produce louder signals* under certain circumstances, but for all around work use your present loose coupler.

The adopted method of shortening the wave length of an aerial is to connect a variable condenser in series. This is done on shipboard when the "distress signals" are sent out and all stations with the long wave require a series condenser to pick up short waves. We know of no instruments which will eliminate excessive static without also weakening to a certain extent the wireless signals. The only way this static may be done away with to an appreciable extent is to shunt a variable condenser across the coupler secondary, which dissipates considerable of the static.

SELENIUM CELL CURRENT.

(331.) L. C. Yeaw, North Adams, Mass., wishes to know the current that will pass through selenium cells.

A. 1. The current that will pass through selenium cells varies, of course, with the resistance of same, and the cells regularly furnished all have different individual resistances in most cases.

At any rate ,the current in amperes is readily deduced from Ohm's law, which states that the current in amperes equals the volts divided by the resistance in ohms. Some of these cells "drop" as low as 4,000 to 5,000 ohms in the light.

PERPETUAL MOTION?

(332.) Harold Jackson, Woodbine, Ia., proposes a scheme whereby (apparently) an electric motor is to be operated from a storage battery, while the motor in turn drives a dynamo that is supposed to recharge the battery.

A. 1. We know of no arrangement, such as we presume you have in mind, whereby an electric motor can be operated from a storage battery, and which motor will in turn drive a dynamo which recharges the battery. This is physically impossible. Remember that the electrical and mechanical losses encountered in overcoming the frictional and resistance effects reacting on such a system absolutely precludes any possibility of "making" energy, resulting in what would really be "perpetual motion."

Want to Swap?

If you have anything to buy, sell or exchange and want to make sure of doing it quickly and at an insignificant cost advertise in the

Scientific Exchange Columns
OF
The Electrical Experimenter

You will find advertised in these columns:

Photographic supplies, Phonographs, Wireless Apparatus, Electrical goods, Bicycles, Motorcycles, Rifles, Gasoline Engines, Microscopes, Books, Skates, Typewriters, Etc.

The owners of these things wish to ***"swap"*** them for **something else, something which you may have.**

The Rates

One cent per word (name and address to be counted) minimum space 3 lines. Average 7 words agate to the line. *Remittance must accompany all orders.*

The Classified Columns of the ELECTRICAL EXPERIMENTER GET RESULTS

More than 40,000 Electrical Experimenters will see your ad.

RE SMALL RADIO AERIALS.

(333.) Patrick J. Leary, Boston, Mass., inquires about indoor aerials.

A. 1. We understand that the special indoor aerial described in the March, 1914, *Electrical Experimenter* works very well, as used by the French engineer, Mr. P. Dosne.

As to your second query on small size aerial, which you propose to erect on top of a piazza roof, we are of the opinion that this will be all right for short range work undoubtedly, and you would not gain anything by placing the wires in this aerial any closer together than about 1½ feet.

TRANSFORMER QUERIES.

(334.) J. Glancy, Mars, Pa., asks several transformer queries.

A. 1. A closed core wireless transformer made up from two ½-K.W. (E. I. Co.), No. 8050 coils, as you suggest, would have a capacity of most probably in the neighborhood of ½ K.W.

A. 2. The No. 8050 coils give about 10,000 volts apiece, and if two of these are used in making up the closed core transformer the secondaries should be connected up on multiple.

A. 3. The difference in voltage ratio in the transformer as you mention would have no effect whatever on the primary frequency, or, rather, the frequency transformation through the transformer, the secondary frequency in any case being identical to that of the primary in cycles per second.

TRANSMITTING CONDENSER QUERIES.

(335.) K. K. Knaell, Mars, Pa., asks several questions on radio transmitting condensers.

A. 1. Undoubtedly the E. I. Co. No. 530 condenser is correct as regards its electrostatic capacity in M. Fs., which, of course, corresponds to the value as given in their catalog. The highest capacity is obtained when the metal rod is pushed through all of the switch posts.

A. 2. The condenser you have should give ample capacity for your wireless transmitting outfit with rotary spark gap, and the best capacity to use in the rotary spark gap oscillatory circuit should be found by varying the condenser switch until the maximum radiation current is obtained on hot wire ammeter in series with the aerial, etc.

Regarding the formula as cited in the "Electro" *wireless course* for the proper capacity of a wireless transmitting condenser this is used in the regular way for a rotary gap, excepting that function "F," or the frequency value, is taken (for rotary gaps) as one-half the number of sparks per second given by the rotary gap. This, of course, you can readily deduce from the number of points on your spark wheel and the speed of the motor. If no rotary spark gap was used in your set then the function "F," or the frequency, in the capacity formula under discussion would be taken to mean the frequency of the alternating current in the primary and secondary circuits of your step-up transformer. This considers that there will be two sparks per cycle of current.

The rotary spark gaps usually cause the

condenser capacity, used in the spark gap oscillatory circuit, to be much reduced, as the spark frequency is, of course, raised very appreciably. Four hundred to 500 sparks per second are quite common with such gaps. For best results with such gaps a synchronous A. C. motor should be used to drive same, of course, so that the sparks will take place at regular periods with relation to the rise and fall of the alternating current wave in the primary and secondary circuits of the transformer. However, non-synchronous rotary spark gaps are widely used and very good results are obtained with them, all things considered.

5 K.W. TRANSFORMER ON 3 K.W. ALTERNATOR.

(336.) R. A. Bawles, Columbus, Ga., has a regular lighting type a.c. transformer and wants to use it for wireless transmitting purposes.

A. 1. If your 5 k.w. transformer of commercial pattern is of the high voltage type, giving 10,000 to 15,000 volts, it will be serviceable for radio transmission purposes.

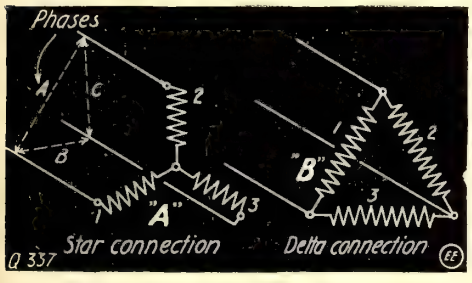
You could not, of course, operate same at full activity with a 3 k.w. alternator, but if the voltage of the a.c. dynamo and the transformer primary correspond, you will get your secondary voltage correctly; but the net output of the transformer will be controlled by the output of the a.c. generator naturally.

It is possible to use lower secondary voltages from the transformer than those above mentioned under certain conditions, and this matter, of course, is something we cannot speak definitely on, as you do not state what secondary voltage the transformer gives.

A. C. HOOK-UPS AND AUDION ACTION.

(337.) John B. Moore, Downsville, N. Y., asks about three-phase "star" and "delta" connections.

A. 1. By the term "star connection" in alternating current work is meant that connection used for three windings on a three-



Alternating Current Circuit Hook-ups, at "A" the Star Connection; at "B," Delta.

phase alternator, motor or transformer, whereby the three windings, when hooked up, appear as in diagram A herewith, which resembles a star, as you will note.

The other connection widely used for similar purposes in alternating current work is that known as the "delta," shown in sketch at B.

A. 2. Relative to the ratio of turns in the primary and secondary windings on the magnetic detector; there are several hundred turns on the secondary coil which would have the same resistance (approximately) as the head 'phones used in connection with same, and the primary winding contains several dozen turns of heavier wire.

The secondary is usually about No. 32 or 34 silk insulated magnet wire and the

Multi-Audi-Fone
The New Wonder in the Wireless World

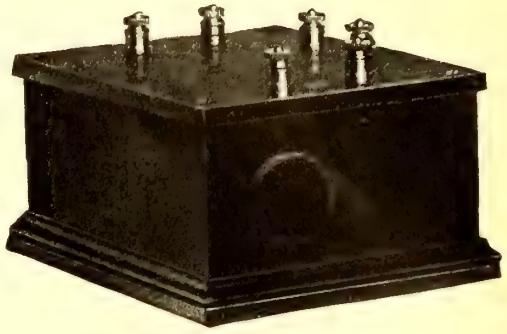
This instrument increases the audibility
ONE THOUSAND FIVE HUNDRED TIMES

Remember that the Multi-Audi-Fone will work equally well with all detectors, including the Audion, and when used with any wireless set will double and even triple the distance, and renders audible hundreds of stations that you can get in no other way, bringing out all nearby stations, as well as those thousands of miles away.

Price, $30.00

SIGNALS CLEARLY HEARD AND ACCURATELY READ WITHOUT HEAD-SETS

The amplification is so great that when two Multi-Audi-Fones are used in tandem and a horn is attached to the receiver, the signals can be heard all over the five story building from our laboratories which are located on the third floor. If the windows are opened, the signals can be heard across the street, even when the trolley is passing.



MULTI-AUDI-FONE

The exact measurements of this instrument are 4¼x3x2⅛ inches. Weight, 12 ounces

It increases the audibility one thousand five hundred times

MULTUM IN PARVO
(Much in Little)



The exact measurements of this instrument are 3¼x2x⅞ inches.

This instrument is indeed "much in little." It is a marvel of efficiency and compactness, for it combines the CRYSTALOI DETECTOR, which is superior to any other, with a COMPLETE AND PERFECT RECEIVER.

The Crystaloi Detector especially designed for us becomes far more sensitive when used in combination with our Multum in Parvo. This compact little instrument has a wave length ranging from 50 to 3,600 meters, and **will go into your vest pocket.**

Price, $20.00

These instruments in combination have a receiving range of 3,000 miles. They are beautifully finished in triple nickel plate and made of hard rubber composition.

One Hundred of These Outfits Sent On Free Trial

Naturally we must follow the rule of first come, first served. Therefore, if you do not get your outfit at once you will understand that there are others ahead of you and that you will get yours when your turn comes.

Offer to Radio Clubs or Others

We will send, at our own expense, one of these complete outfits to any radio club or any two persons. If you want to try this newest and greatest wireless improvement, sign the following letter. Have it guaranteed by your father or some other responsible man, and we will send the outfit to you on trial.

MULTI-AUDI-FONE: 273 Morris Ave., Elizabeth, N. J., 1915.

Gentlemen:—Please send us, at your expense, one of your complete outfits upon these conditions: First—We agree in no way to mar or injure any of the instruments by taking them apart. Second—We agree to repack carefully any of the instruments we do not buy in the same box in which we received them. The prices of these instruments are understood to be: Multi-Audi-Fone, $30; Multum in Parvo, $20. Head-Set, $5; the outfit, $55. Third—We agree to remit within ten days of receipt of the instruments for such of them as we decide to purchase and to repack the rest as above agreed, and return the same at your expense within ten days after they are received by us.

Very truly yours,

Two Signatures are required

No apparatus will be sent unless responsible person signs this Guarantee

(Name)..... Address.....

(Name)..... Address.....

I hereby guarantee that the above agreement will be faithfully kept and performed.

(Name)..... Address.....

SIGN—TEAR OFF—MAIL TO-DAY

Send For Our Circular. Correspondence Solicited.

MULTI-AUDI-FONE—273 Morris Avenue, Elizabeth, N. J.

primary about No. 24 silk or cotton insulated magnet wire.

A. 3. The principle upon which the Audion detector operates is that of causing a variation or change in the absolute value or strength of a stream of electrons. A variation in this stream of electrons (as produced in the Audion bulb by the incandescent lamp filament in same) is created by a *trigger* action. This *trigger* action is carried out in practise by means of a wire grid and a metal plate placed in the proper position about the incandescent filament. The grid and the plate are connected up to the Hertzian wave circuits of the radio receptor or receiving set. The incoming wireless signals in the form of Hertzian or etheric waves thereby cause a change in the electron stream produced in the Audion bulb, and this variation in the quantity of electrons allowed to strike the plate in same is registered in a pair of sensitive telephone receivers connected to the plate in the Audion bulb.

RADIO OPERATOR'S SALARY.

(338) M. H. Chapman, Baldwinsville, N. Y., asks about the demand for radio operators and the remuneration.

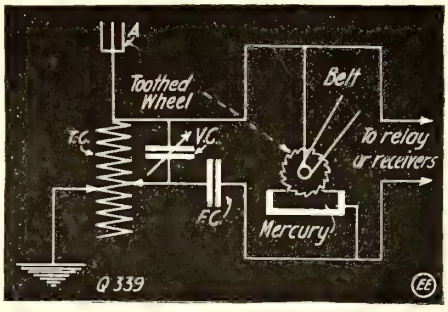
A. 1. There is at present a good chance for wireless operators, especially in view of the great demand created owing to the European war, which has taken many operators from this side of the world, and thus there are numerous openings both here and abroad.

On the average, a ship radio operator's salary is approximately $35 to $40 a month in most cases, which includes board and medical attendance as well as berth.

Land operators get from $75 to $125 a month, depending upon the station they are appointed to, and in most cases a percentage or bonus is paid on the number of messages handled by the operator, which on shipboard of course depends a great deal on the personality and abilities of the operator himself.

LODGE-MUIRHEAD MERCURY COHERER.

(339.) L. Bosserman, Pleasanton, Kan.,



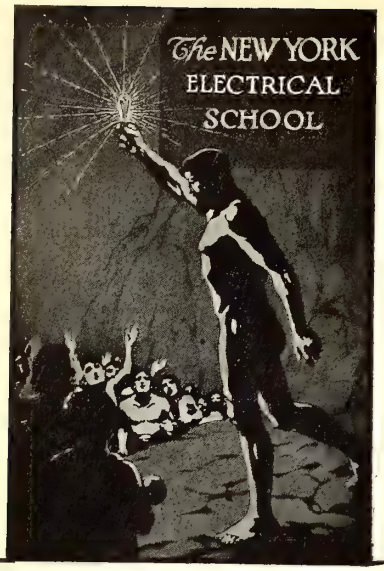
Mercury Coherer Hook-up.

is interested in the Lodge-Muirhead mercury coherer.

A. 1. Concerning the construction of a Lodge-Muirhead mercury coherer, the brass wheel used in same may be about 1 inch or more in diameter, or even less, and the number of teeth is immaterial. It is rotated by a belt or otherwise at fair speed and the teeth of the wheel should just barely touch the mercury.

This adjustment, of course, is very easily ascertained when trying out the detector in the regular wireless circuit. The rotating tooth wheel should be movable vertically on a slide or else the mercury cup should be adjustable as to height.

Diagram is shown herewith for the connection of this mercury coherer and regular tuning coil, condensers, etc. It has a receiving range on par with other coherers.



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NATIONAL RADIO SCHOOL, 1405 U St. Washington, D. C.

A. C. GENERATOR DESIGN.

(340) Fred V. Bechtold, North Manchester, Ind., asks several questions on alternating-current generator design.

A. 1. In reference to your small alternating-current generator, the armature volts developed by same is dependent upon three main factors, viz.: upon the flux in lines per square inch of field-pole cross-sectional area; upon the number of armature conductors per slot (and total conductors, of course), and the revolutions per minute at which the armature is rotated.

You will thus see how it is possible to increase the voltage on your alternator by varying any of these factors. If you desire to keep the speed of the machine the same, and also the number of the armature conductors, then you have only one alternative, which is to increase the field-flux density per square inch. This means that more powerful magnet coils must be used in the manner you suggest, and it is doubtful whether there is room on the field frame to do this.

We would refer you to any book on the subject of dynamo machine design for the data you desire, and several good books on this subject are handled by our book department. You may use a storage battery for exciting the field as you mention.

In changing your field winding for low voltage, the cross-sectional area of the copper wire for the coils is increased proportionately as the direct ratio of the new voltage compared to the original voltage rating for which the coils were designed. Also for the low-voltage winding a proportionately less number of turns would also be used.

RESISTANCE AND DAMPING.

(341) J. L. Green, Rosser, Man., Can., asks several questions on damping, resistance, etc.

A. 1. The matter of loose-coupler wave lengths was explained somewhat in the September, 1914, *Electrical Experimenter*. The primary and secondary windings of the loose coupler when shunted by variable condensers are considered as distinct oscillatory circuits, and the regular wave-length formula is applied to them for general calculations.

We would suggest the ⅜-inch thickness of hard rubber for the small switchboard you mention. The reason why, as you mention, some text-book writers and others often suggest loose couplers for wireless work having a comparatively small number of turns to be counter-balanced by condenser capacity in tuning oscillatory circuits, is due to the fact that if a great number of turns are used in the coils there is also a high ohmic resistance encountered.

This directly affects the "damping" of the circuit, of course, as the greater the ohmic resistance of any oscillatory circuit the higher the "damping," and vice versa.

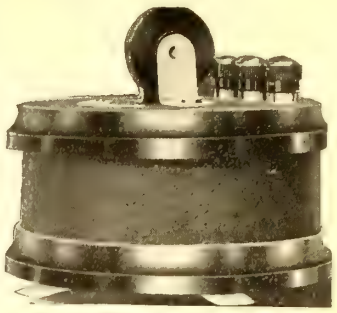
This relation between the resistance of the circuit and the damping is observed from the following formula for this function as cited in Commander S. S. Robinson's "Manual of Wireless Telegraphy for Naval Electricians" (1913 Edition). The formula is:

$$d = \frac{R}{2 n L};$$

where d = damping of any circuit.
R = total resistance (high frequency value in radio circuit, of course) in ohms.
n = frequency of oscillations in circuit.
L = self-induction of circuit in Henries.

2100 MILES
FOR SIX DOLLARS
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SUPER-SENSITIVE



CRYSTALOI DETECTOR
TYPE AA $6.00.
Weight, Two Pounds.

Hilo, Hawaii, T. H., July 14, 1915.
EUGENE T. TURNEY CO., New York City.

Dear Sirs—After having tested your Crystaloi type AA Wireless Detector for two months on both the Atlantic and Pacific sides, under practically all conditions which wireless is subject to (static, freaks, etc.), I feel it my duty to tell you of a few "stunts" that I have accomplished with it.

On May 29, while 915 miles south of Scotland Lightship, copied all of W S T (Miami, Florida) press through static which was heavy. The signals came in clear and strong. The steamer "Honolulan" then about 100 miles to the south of us was unable to hear W S T on account of heavy static. I gave him a copy of the press.

On June 2 at 1 a. m. copied Miami's press while on the Pacific side, about 370 miles west of Balboa, Canal Zone; signals were clear and strong and did not fade as is usually the case with most all other Detectors. This was a distance of 1,600 miles, over part of Central America and the Gulf of Mexico, and was accomplished through quite a heavy static which is prevalent in the Tropics at night in the summer.

On the next night, June 3, I again copied Miami's press at a distance of 1,800 miles. The S.S. "Kansan" at that time was about 100 miles away and he could not hear W S T at all and said that the static knocked his point. But my Crystaloi was not in the least affected by the heavy splashes of X.

July 9, while at anchor in Kahului harbor, Hawaiian Islands, copied K P H San Francisco press at a distance of 2,100 miles, which is extremely good work for this time of the year.

I am more than pleased with your Detector and would recommend it to anyone who desires a Detector for extreme long distance combined with ease of operation and simplicity. It does not fall short one point in what you claim for it. Wishing you continued success, I am,

Respectfully yours, A. H. RANDOW, Operator S.S. "Dakotan."

Full Information on request. EUGENE T. TURNEY CO., Inc., 2595 Third Ave., NEW YORK CITY

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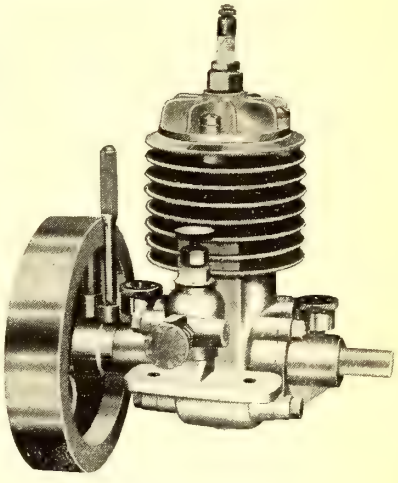
The new prices for this engine, completely finished and ready to run, with exception of batteries, coil and gas tank are as follows:

Stationary Engine mounted on maple subbase and with 2½ in. by 1¾ in. face pulley $17.50

Marine type Engine with 7 in.—2 blade aluminum propeller $17.50

Send 25 cents in stamps or coin for full size blue prints of this engine.

Remit by Postal or Express Money Order.

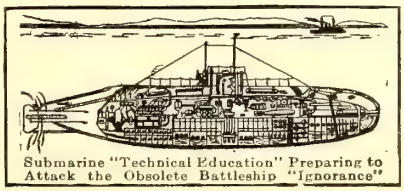


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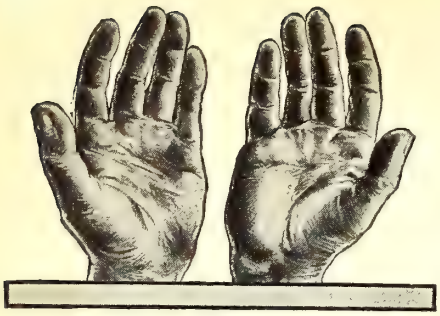


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☐ Electric Railways	☐ Civil Service
☐ Dynamo Running	☐ Architecture
☐ Telep. & Teleg. Eng.	☐ Contracting & Build.
☐ Mechanical Eng'r'g	☐ Structural Engin'g
☐ Mechanical Drafting	☐ Plumb'g & Heat'g
☐ Shop Practice	☐ Civil Engineering
☐ Steam Engineering	☐ Salesmanship
☐ Mine Fore. & Supt.	☐ Advertising
☐ Chemistry	☐ Agriculture

Name _____

Street and No. _____

City _____ State _____

Present Occupation _____

USE OF TWO LOOSE COUPLERS.

(342) George Meister, Newark, N. J., asks for hook-up for two loose couplers in a radio receiving station.

A. 1. Diagram is given herewith for connection of two loose couplers, with the other usual instruments. In this way the second loose coupler serves as a duplex loading coil in both primary and secondary

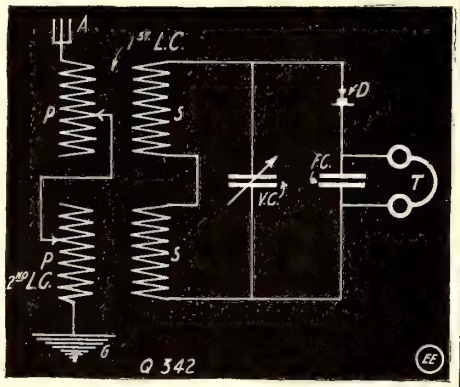


Diagram for Two Loose-Couplers.

of the second coupler with a wide range of coupling.

TESLA COILS FOR RADIO WORK.

(343) Fred Kessler, Springfield, Ill., speaks of using a Tesla high-frequency coil for radio-telegraphic sending circuits.

A. 1. This is not practical and it is never employed when the usual form of Tesla coil is considered. Of course, every wireless transmitting set constitutes a special form of high-frequency Tesla or Oudin coil, but the ratios of the primary and secondary windings of these wireless high-frequency coils is many times lower than those existing in regular Tesla transformers used for demonstration and experimental work.

A. 2. The matter of aerial wave lengths was covered completely in an exhaustive article which appeared in the February, 1915, issue of *The Electrical Experimenter*. Copy of same may be procured from the publishers, prepaid, for 10 cents.

Roughly, it is: The wave length is equal to four and a half times the length in meters of the aerial wire plus the length of lead-in and ground wires.

RAISING DYNAMO POTENTIALS.

(344) William L. Crawford, Lima, O., wishes to know if he can procure a transformer to raise the voltage of his type "SS" 6-volt, 4-ampere direct-current dynamo, and thereby the output also.

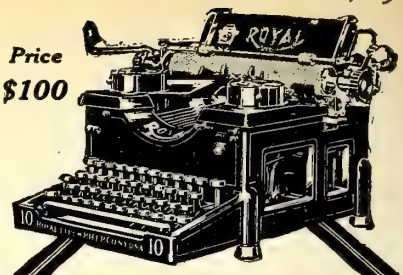
A. 1. We do not know of any transforming device of the nature you mention for increasing the voltage developed by a dynamo such as the Knapp type "SS" machine.

You would not gain anything by such a transformation or boosting of the voltage, as of course the net energy will be reduced by such a transformation, as no machine operates at perfect efficiency. If you rewind the dynamo to give a higher voltage then the amperage will be less than it originally was. The watts (volts × amperes) will be roughly the same.

STORMS TIE UP WIRELESS.

Because of equinoctial storms, the Atlantic Communication Co., which maintains the wireless station at Sayville, L. I., has announced that until further notice it will be unable to accept any private messages to Nauen, near Berlin.

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PATENT ADVICE

Edited by H. GERNSBACK

In this Department we will publish such matter as is of interest to inventors and particularly to those who are in doubt as to certain Patent Phases. Questions addressed to "Patent Advice" cannot be answered by mail. Sketches and descriptions must be clear and explicit. Only one side of sheet should be written on.

DESIGN PATENTS.

(19) H. B. Meadowcraft, San Antonio, Tex., wants to know what a design patent is, and what it costs to obtain one.

(A.) Design patents may be granted for any new ornamental design or article of manufacture. For instance, you might design a fork or spoon which has a new ornamental design which might be a flower or any other pattern which has not been used before. In order to keep others from copying the design, one applies for a *design patent* by submitting the design to the patent office. Design patents may be for any new distinctive design or ornaments which may be adopted on silks, fancy fabrics, cut glass, metals, emblems, jewelry, pictures, shapes and almost every other article of manufacture. If a design patent is obtained, the patentee has the right to mark the article patented which gives notice to his competitors that the same design must not be used by others.

Design patents are granted for three and one-half, seven and 14 years, at the option of the applicant, but it cannot be extended at the expiration of the period for which the original patent was granted.

The Government fee for three and one-half years for a design patent is $10, for seven years $15 and 14 years $30. Full fee must be paid at the time the application is filed. To this must be added the fee which the patent attorney will charge for his work in preparing the specifications and drawings. These fees vary from $25 upwards, all depending on how much work is to be performed.

WIRELESS TELEPHONE TRANSMITTER PATENTABLE?

(20) I. Rosin, Cincinnati, O., sends in a sketch and description of a new wireless telephone transmitter which our correspondent claims can carry very heavy currents. He wishes to know whether the invention is practical and patentable.

(A.) The invention presents nothing not known so far, and while a patent might be obtained on some technical points, we doubt whether the device is satisfactory at all, for it is nothing but a relaying scheme whereby the microphone operates a relay system which actuates another large capacity form of microphone. It does not present a good solution of a heavy current carrying microphone such as is desirable in wireless telephony.

EMPLOYER AND EMPLOYEE ON PATENTS.

(21) H. Cabot, Boston, Mass., wishes to know if an employer is not entitled to the invention of an employee if the invention has been made on the employer's premises.

(A.) An employer merely by employing an employee is not entitled to the invention of the employee unless there is an express contract to assign it to him. In other words, if no contract exists between the employee and the employer whereby the former is to assign his patent right to the latter, it will be the property of the original inventor.

COST OF PATENT IN UNITED STATES.

(22) Hamilton B. Lancaster, Lynn, Mass., wants to know what the Government fee is for a simple invention in the United States.

(A.) When you apply for a patent of your invention there are two fees, the first Government fee when applying for patent being $15. When the Government has finally allowed the patent, a final payment of $20 must be made to the Government before the patent can be issued. In other words, the total fee that the Government requires on any patent is $35. Of course, this is only the Government fee and does not include the fee of the patent attorney who prepares the papers, drawings, etc. Usually such a fee to the patent attorney varies from $25 upwards, all depending on how much work has to be performed, how many patents must be looked up, and authorities consulted, etc. An ordinary patent with one sheet of drawings and specifications that are not too complicated will usually amount from $25 to $40 with the average patent attorney.

CAN SWITCH BE PATENTED?

(23) Newell M. Ferris, New York, has sent in a drawing and explanation of a new flush switch, and he wants to know whether we would advise him to patent it, also if there is a demand for such a switch, and whether he ought to submit it to some electrical manufacturing company in order to get financial aid for patent.

(A.) While the device submitted is unquestionably novel, and while we think that a patent might be obtained upon it on account of the constructional details, we do not think that it would be worth while to do so, as it appears to us that the device is entirely unpractical and has several features that make it particularly undesirable. The biggest objection is a sliding movement covering quite a little range and a necessarily large hole which thereby is necessitated in order to move the handle back and forward.

We do not think it would be passed by the Board of Fire Underwriters in its present shape and therefore would be valueless.

ABOUT TRADE-MARKS.

(24) A. B. McCann, Los Angeles, Cal., inquires about trade-marks, where used and how obtained.

(A.) A trade-mark may be registered by an individual, firm or corporation in the United States or in any country granting similar privileges to citizens of the United States when used in commerce with foreign nations, provided it is a proper

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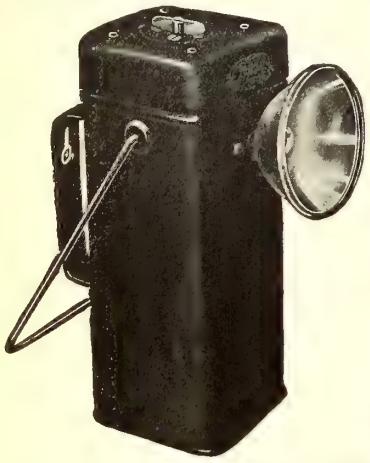
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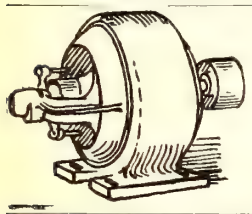


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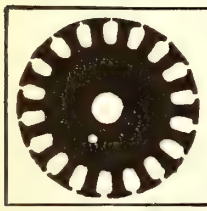
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Briefly, a trade-mark is a particular or distinctive design by which the goods of the owner are distinguished from other goods of a similar class. No geographical names or insignia of the United States, municipality, foreign nations or marks which are descriptive of the goods upon which they are used can be trade-marked. No emblem of a fraternal society can be used. The meaning of "descriptive of the goods" is that, for instance, you could not obtain a trade-mark if you were a manufacturer of electrical lamps, and you wanted to trade-mark a picture of the lamp. This would be held as a trade-mark descriptive of the goods. You might obtain a trade-mark of your own name if presented in a distinctive manner providing it did not conflict with any already existing similar name.

In other words, a trade-mark is nothing but a seal which is used in order to brand or distinguish your goods from other goods. It is also necessary that once a trade-mark has been obtained, it cannot be changed in any way. This is an important thing to consider and should be very carefully weighed before application is made, for no change can be made without effecting the validity of the mark.

IS RADIO SCHEME PATENTABLE?

(25) S. Beecher, Campbell, Tex., sends in a sketch of a device to control machinery on a small boat by radio, and wants to know if it is patentable.

(A.) Nothing new is contained in the idea; as a matter of fact, similar schemes have been shown repeatedly in this magazine, and any text book containing some chapters on radio tele-mechanics will show a variety of such devices.

We do not think it is possible to obtain a patent that is worth while on this device.

AN INGENIOUS LAND TORPEDO.

(26) William E. Egan, Troy, N. Y., submits an ingenious torpedo which is supposed to move under its own power from one trench to another. When arriving at the enemy's trench several hundred pounds of gun powder are supposed to be exploded at any desired time by means of a flexible electrical cable attached to the machine.

(A.) The idea is certainly novel and to our knowledge nothing like this has ever appeared in print so far. While there are several objections to a scheme of this kind, it might prove of real use to countries at war if all the details were worked out fully. One of the main objections of the invention in its present shape is that it is too vulnerable, in other words, even a small shell when shot at the machine would not only wreck it but blow it up, and if this happened near the trench from which it had been sent it would prove as deadly to the sender as to the enemy. We think the invention is patentable, but we would suggest to cover the machine with an inverted "bath-tub" shape armor protector in order that a shell fired from the enemy will not wreck and destroy the machine before it reaches its destination. We would advise our correspondent to get in touch with one of the patent attorneys to see what has been done in this art before.

HOW LONG DOES IT TAKE TO GET PATENT?

(27) Hamilton Brown, Springfield, Ill., claims he has invented a new electrical bell on which he feels sure that a patent will be granted. He wants to know how long it will take him to obtain a patent once he has made application.

(A.) It is impossible to prophesy how long it will take for a patent to issue once applied for. It depends entirely upon how much work is at hand in the particular department of the patent office, also how fast the applicant's attorney will do the work. It happens not infrequently that a patent takes from six to eight years to issue for the reason that changes of claims, amendments, etc., have been made after the application has been made. Some patents have issued as soon as two months, but such cases are extremely rare.

We would say that the average patent takes from eight months to a year to issue after the application.

SCIENTISTS WILL STUDY STRAY ELECTRIC CURRENT IN THE ATMOSPHERE.

Wireless experts are congratulating themselves on the increased facilities now afforded for studying the by-products of nature's laboratory, namely, "strays" or "x's." The completion of the new and powerful radio station at Yokohama, Japan, not only facilitates wireless communication across the Pacific but likewise opens a broader field for investigation of atmospheric electricity.

Long-distance stations, due to their high power receiving apparatus, are best equipped to give data on etheric disturbances. Scientists located at San Francisco, Hawaii and Yokohama will collaborate to reach a definite understanding of these stray currents.

Dr. W. Eccles is at the head of the investigation, having been appointed by the British Association to carry on the work.

Very little is known about the origin of "strays" or "x's." They were given these names for brevity, about 1887 or 1888, and were more recently called "static." They are familiar to everyone who has worn wireless receivers in one or more of their various forms.

It is natural that we should jump at the conclusion that "strays" or static is due to lightning, but this theory ignores the fact that they may be due to forces exterior to the earth. There is nothing unreasonable in supposing that the sun may send us occasional electric waves.

The formation of spots on the sun or the constant colossal changes of relative position of the various heavenly bodies may give rise to electric waves that reach the earth and cause these disturbances. It is questions such as these that the British Association is to solve, if possible.

Another subject under observation is the part played by the atmosphere in the variations of signal strength, these variations in relation to weather conditions, the time of day and with the position of such freak disturbances on the face of the globe.

RECEIVING WIRELESS MESSAGES WITH ODD AERIALS.

(*Continued from page* 274.)

odd aerials are used inside of a house no results can be had unless the house is constructed of stone or wood. A house containing steel beams or a mass of other iron work will make the use of such indoor aerials out of the question.

We publish these suggestions not as a mere curiosity, but it is thought that any one of these schemes might prove of invaluable benefit in case of emergency. Storms, a fire, sleet, etc., might put the regular aerial out of commission; in that case some of the above-suggested freak aerials could be used to possibly good advantage. Note that most of these odd aerials can be used for sending as well as receiving. For sending purposes they should, of course, be well insulated.

BARON MUNCHHAUSEN'S NEW SCIENTIFIC ADVENTURES.

(*Continued from page 248.*)

explored on this dead world. Besides, the meteors had become so alarmingly frequent that it would be only a matter of time when one of us would be killed.

"Flitternix wanted to return to earth at once, for he itched to present a lecture to the American Astronomical Society, whose honorary president he is. I, however, had more ambitious plans. I once had looked through the great telescope at the Lowell Observatory at Flagstaff, Ariz. If I live to be a thousand years old I will never forget the glorious sight which then presented itself to my eyes.

†"I saw a ball, lighted up dazzlingly at both extremities. I saw great patches of an ochre red scattered over the surface of the sphere and I had seen dark blue areas among the vast ochre patches. Over the latter runs a mass of fine lines, nearly all of them connecting with the white caps at each extremity. Moreover, these fine lines cause one to gasp involuntarily, for they are as straight and true as if laid out with a rule and pencil. More astonishing yet, some of these lines run absolutely parallel with other ones for the whole length of their extent. And more wonderful yet, whenever two or more lines meet in a junction there is invariably a round black point.

"The ball I had been looking at transfixed for a long time was Mars, the nearest planet to earth, then 37,000,000 miles distant from the latter. Prof. Percival Lowell, the greatest living authority on Martian research work, has convinced the scientific world that the dazzling white caps at the poles of this planet are the polar snow fields. The great ochre patches are desert land, while the dark blue areas represent large tracts of fertile land and its resulting vegetation.

"Now, according to well-known physical laws, proved beyond discussion, the smaller a body the quicker it will cool off. All planets and their moons once were white-hot like our sun. The smaller ones cooled off first and the larger ones are not cold as yet. Thus the earth, which measures 7,912 miles in diameter, is still red-hot in its interior, as is proved by its active volcanoes. The moon, which is but 2,164 miles across, cooled off ages ago. The oceans once filling its beds then filtered down in its bowels, there to freeze solid, for there was no heat to keep the water fluid. Its atmosphere, which was formerly as dense as that of our earth, was gradually thrown off into space, till to-day practically no atmosphere remains. Thus the moon to-day rolls on through space a dead world.

"The planet Mars, measuring 4,363 miles in diameter, as will be seen, is only twice as large as our moon and much smaller than the earth. Consequently it must be rapidly nearing its extinction, the same as the moon. Its oceans are already dry, while most of the land is desert. The atmosphere has nearly all gone too, proved by the fact that we practically never observe clouds on Mars through the telescope. But there must be water on the planet as yet, this being irrefutably proved by its polar snow caps. This view is further strengthened by the fact that these caps undergo seasonal changes. As the sun beats down upon them we see first the one, then the other, grow smaller in size, till at the end of the Martian mid-summer the northern one has disappeared almost entirely. During the next hot season the same happens to the southern one. Where has this water—*the only remaining water on Mars*—gone? It cannot have filtered into the interior, for if it had, we could not possibly witness the reappearance of the polar snow fields, every Martian year, as we actually do. Where, then, does the water go?

"Dr. Lowell solved the problem in a brilliant as well as ingenious manner.

"His view—and it is shared by most of our scientists to-day—is that Mars is inhabited by a thinking people, fighting a heroic battle for their existence. Without water, life, as we know it, cannot exist. Now ages ago the shortage of water had made itself felt on Mars. Long before the first cave man appeared on earth Mars had been an old world, where civilized peoples had reigned for centuries. While our ancestors were still jumping from limb to limb among the trees in primordial forests and jungles, the water problem on Mars had become acute. The fertile lands were fast turning into deserts for rains had become more and more infrequent, until they had stopped almost entirely. Furthermore, as Mars is flat without mountains or elevations of any sort, there could not be any natural rivers to convey the water to the plains and valleys as is the case on our world. The Martians, seeing utter extermination staring them in the face, proceeded to save their race. They did precisely the same thing as we are already doing in Western America and the Egyptians are doing in Egypt, namely, irrigation of deserts or semi-deserts on a large scale. Our recent Roosevelt dam in Arizona offers a good example of this. Our engineers on earth have to bring the water to the deserts, precisely as the

This Splendid

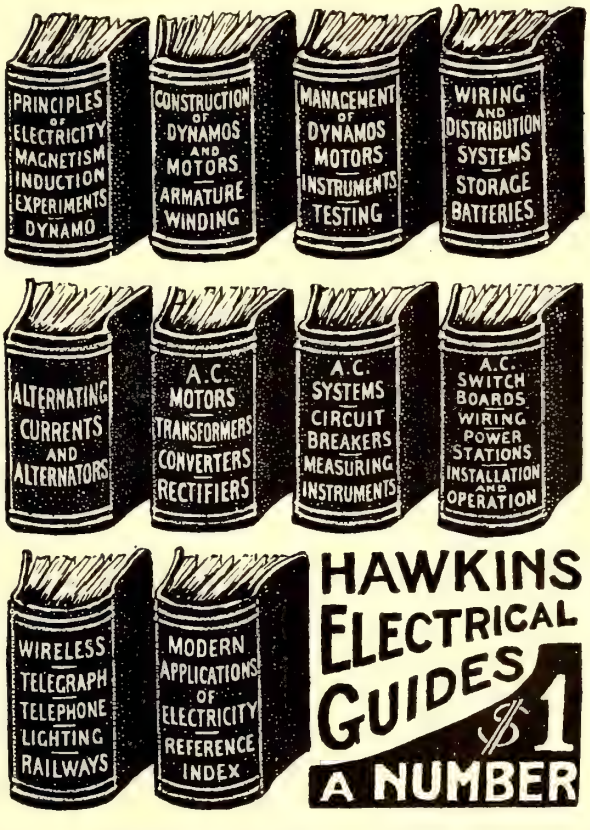
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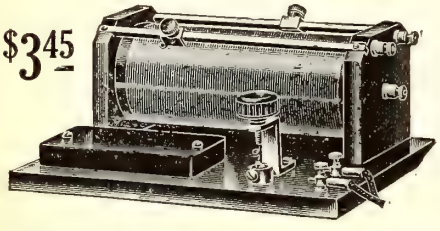
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Martian engineers must have been doing it for centuries past.

"On earth, however, this is a comparatively simple matter, for here we have rivers and lakes in abundance which can be tapped with ease. Not so on Mars. The only remaining water there is found around the poles; by sheer necessity, therefore, the Martians had to go to the poles for their water supply, and this is exactly what our telescopes reveal that they did. For the long, unswerving straight lines which we see are part of the canals bringing the water down from the poles to the desert land there to irrigate it. So far the Lowell observatory has discovered almost 600 canals, but there are doubtless many more. They criss-cross the entire surface of the planet in every conceivable direction, most of them, however, running due north and south in the direction of the poles. Not only do the canals cross the desert lands, but we see them carried bodily across the dark blue areas which we know to be irrigated vegetation tracts. The fact that the canals run across these areas is another proof that they are not oceans, as had been thought at one time.

"Now the lines which we see running over the planet are really not the canals themselves, but are simply wide strips of vegetation fertilized and kept alive by the water from the canals. The average width of the canals proper Dr. Lowell estimates to be about six miles. There are some of them, however, which are thought to be much wider than this. The length of these canals, however, is stupendous. There are some canals which actually measure 3,400 miles. A great many are over 2,000 miles long. Dozens of them run for 1,000 miles, and nearly all of the canals run in absolutely straight lines.

"The circular black points, mentioned above, which we see almost invariably at the juncture of one or more canals, are termed oases. They also represent vast tracts of vegetation and probably contain large cities, farms and so forth.

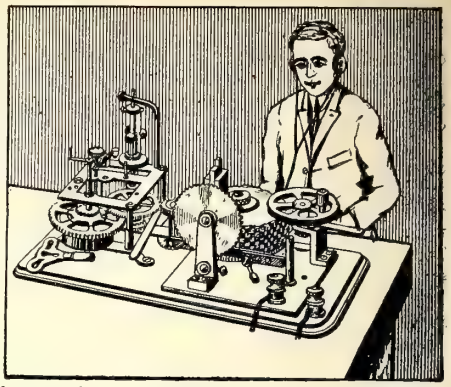
"It must convince the strongest opponent of Dr. Lowell's theory, when viewing Mars and its canals through a first-class telescope, that these wonderfully straight lines cannot by any possible chance be the work of Nature. Its counterpart is found nowhere on earth nor in the heavens. And if by any chance, for argument's sake, these lines should be of a natural origin, so many of them could not for any conceivable cause join and meet as they do and form these exact circular areas. Their artificial origin is too apparent and cannot be otherwise considered to-day. Dr. Lowell's theory has so far withstood the onslaughts of all opponents, as a matter of fact, his explanation is to-day accepted almost universally.

"But how do the Martians move the tremendous masses of water through their canals? For, as explained already, Mars is entirely level, and water does not flow on a level surface without a "head." Moreover, during one season it must needs flow from the north towards the equator, when the northern polar snow cap melts under the influence of the sun's heat. *During the next season, however, this flow must be reversed* for now the south polar snow cap melts, with a resulting flow of the water from the south to the north.

"But how do the Martians succeed in moving the water? We don't know. Even Professor Lowell is silent on this point. Terrestrial science simply has as yet not advanced enough to offer an explanation.†

"Well, to make a long story short, Flitternix and I decided to voyage to Planet Mars. My little astronomical lecture was given solely for the purpose of refreshing

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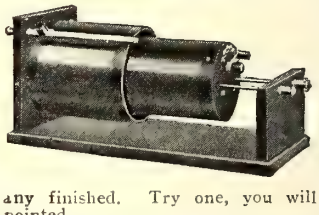


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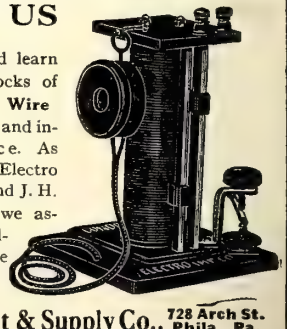


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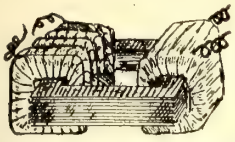
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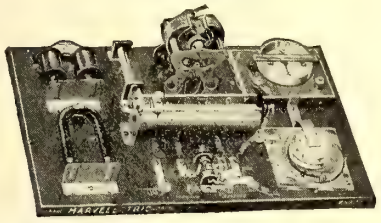
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your mind as to Mars in order that future reports which I shall make to you from the planet will be better understood by you and your friends.

"If our 'Interstellar' was able to succeed in reaching the moon without mishap, I felt sure that the trip to Mars would not be an unduly difficult undertaking. Flitternix was of the same opinion. We calculated that the intervening 50 million miles separating the moon from Mars should be negotiated by our space flyer within 30 days, barring no accidents. While this may seem like a short time to cover such an immense distance, our speed of 1,600,000 miles a day, or 66,666 miles an hour, is only a trifle greater than †the speed of the earth (65,533 miles an hour) as it travels in its orbit around the sun.†

"We immediately made our preparations and within six hours after I had emerged from the crater, the 'Interstellar' had left the moon.

"And now for a little surprise! No doubt you noted that my voice does not sound the same as usual. You will have observed, furthermore, that I did not stop talking since I started. To break the news gently to you, I am not talking at all! While you are listening to my voice at this minute, I will be some 1,100,000 miles distant from the moon heading towards Mars!

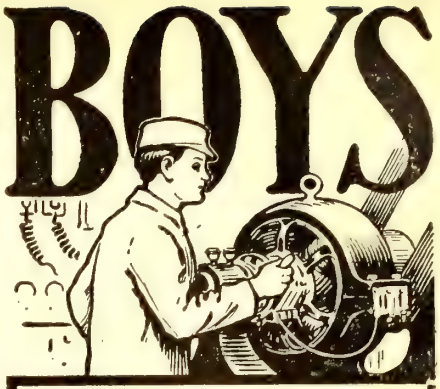
"The explanation? Simplicity as usual!

"Before leaving in our 'Interstellar' we stretched an immense aerial inside of the canyon, the one of which I spoke to you several days ago. As you will remember, I told you then that it was open but a few feet across its opening at the top. It thus formed a long, narrow slit at the top into which there was little likelihood of meteors dropping, which could destroy the aerial. We stretched four wires in all along the inside of the canyon, spacing the strands six feet apart. Each strand is 6,000 feet long in order to give the required long wave length in transmitting as well as receiving impulses between Mars and the Moon, as well as between the latter and the Earth.

"To this aerial I connected my latest invention, by *Interplanetarian Radiotomatic*. It is nothing but an ingenious adaptation of modern tele-mechanics and works as follows:

"When the aerial receives a certain number of equally spaced dashes an ultra-sensitive detector is actuated upon which in turn operates a gas-valve relay. This relay then closes its contacts, which sets in motion the well-known telegraphone, invented by Poulsen. A second ultra-sensitive detector, also connected to the aerial, is in series with the *registering* electro-magnets of the telegraphone; in front of these magnets runs the moving steel wire, on which are then recorded the impulses coming in over the aerial. You will observe that no message can thus be recorded unless the original *key dashes* unlock the telegraphone mechanism. At the end of the message the same number of equally spaced dashes will lock the telegraphone mechanism. The recorded message is now ready for retransmission at any time desired. This is accomplished in a simple manner too.

"I took our 300-day clock and fastened upon it a contact which would be closed at exactly 11 p.m. every night and would be opened again at 12 o'clock midnight. This contact closes a circuit in which is included the telegraphone mechanism. As soon as it starts the steel wire with its recorded message begins to reel off in front of the two *reproducing* electro magnets, which in turn are connected with a special telephone receiver. Thus the telephone receiver will begin to talk its message (if



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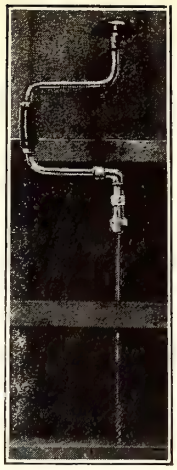
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one was sent during that day) every evening at 11 o'clock.

"But connected to the telephone receiver are several amplifiers, arranged in cascade. The last amplifier is attached to the mouthpiece of the transmitter of my wireless telephone. Thus the weakest recorded talk on the telegraphone wire will cause the telephone of the last amplifier to talk into the wireless transmitter louder than myself.

"Now my 300-day clock every night at 11 o'clock also closes the contacts of a powerful relay, which in turn operates the generating plant of my wireless telephone, disconnecting it at midnight. Therefore when the amplifier with its telephone begins to talk into the transmitter of the wireless telephone, there will always be enough power to transmit it to you on Earth.

"As soon as we arrive on Mars we will in all probability find all the necessary materials to erect a giant Radio telephone plant, and if we succeed we will send daily messages to the Moon, while my radiotomatic relaying plant will transmit the messages to you every night. I might also mention that my ultra-sensitive detector contains two radio-active substances, making the detector such a marvelously sensitive instrument that it will work a set of amplifiers in cascade *when an electric pocket buzzer is operated one hundred and fifty miles away from it, connected to the ground only and using no aerial!*

"You might say: 'Why use the relaying plant on the Moon at all? Why not transmit from Mars to the Earth directly?'

"The reason is that when the weak impulses arrive from Mars, after having traveled from 50 to 60 million miles, they cannot be sufficiently strong to pass through the Earth's thick atmosphere, always charged with electricity and 'static.' It is far better that the weak impulses should operate the relaying plant first and send out from there very strong impulses which have but to travel some 238,000 miles to Earth.

"We tested the plant thoroughly and after we had satisfied ourselves that it would work for at least 300 days I opened the telegraphone circuit and began to register this message to you. It will be the last one which you will receive for 30 days or more. As it must needs take us from five to 10 days to build a transmitting plant on Mars, you need not expect to hear from us for from 35 to 40 days. You might, therefore, commence to 'listen in' beginning with the 35th day from tonight. No message can ever be repeated, for the *'wiping'* electro-magnets of the telegraphone wipe out the magnetic impulses from the steel wire as quickly as they pass the transmitting magnets. Neither can you transmit a message to me, for no provisions were made to relay your messages to us when on Mars.

"I will now bid you adieu, my boy. Think of us during the next 30 days! Good-bye—good-bye.....!"

There was a silence for some seconds, and as I was still listening awestruck, I was suddenly startled by another voice breaking in:

"Hallo there Alier, this is Professor Flitternix. How's Yankton? Beastly old town! Was once forced to sleep on a billiard table in the Palace Hotel, as all the rooms were full. The robbers charged me $2.50 for the "room" plus the regulation rate of 50 cents an hour for the use of the billiard table! Mean town, that Yankton! Well, good-bye....."

There was a snapping noise and the rhythmic low sizzling sound stopped abruptly. All was quiet once more.

(*To be continued.*)

THE AURORA BOREALIS OR THE NORTHERN LIGHTS.

(*Continued from page* 245.)

It is possible to produce an artificial Auroral effect in the laboratory, as Fig. 3 shows. Between the poles of a powerful electro-magnet is placed an exhausted glass bulb. When a high-voltage electric current is connected with such an exhausted globe in the manner shown and also when the magnetic flux in the magnets is caused to pass through the bulb, a remarkable change takes place, which has considerable bearing on the apparent action occurring in the Aurora Borealis as seen in nature. The artificial Auroras produced in the exhausted bulb, as here described, take a spiral form, the spirals tending to point toward the magnetic poles. This seems to confirm the theory that the streamers of the Aurora Borealis in nature are composed of electrons, descending to the outer gaseous envelope of the earth sometimes from a height as great as 300 miles. These spiral down, following the lines of magnetic force, toward the poles; the spiral at the same time gradually closing up and decreasing in diameter as the field strength increases. The luminous globe becomes brighter, due to this concentration and the improved conductivity which results; a combined effect of the magnetic and electric fields which are strongest at the poles, also helping to increase the conductivity. In the proximity or neighborhood of the conducting layer the Auroral streamers or rays come to an end, as the electrons or electrically charged particles then return upon their paths and spiral up again.

Regarding the state of the *electrical charge* in the atmosphere surrounding the earth at the periods when the Aurora Borealis occurs it was found by Andree, who made careful measurements with a sensitive electrometer, that before the appearance of an Aurora, the positive electric potential of the atmosphere diminished abruptly and in some cases it even became "negative." This also usually occurs when it rains, but after a rain storm the positive charge in the atmosphere generally returns promptly. When the Aurora takes place, the atmospheric potential takes up as before and quite rapidly a high-positive electro-static value. Thus we see that the Aurora Borealis does affect directly the *electrical equilibrium* of our globe, and therefore it is perceived how it can affect without any question the electrical telegraph lines and wireless systems built by man, and which use, of course, in any case a power which is but an infinitesimal fraction of the vast amount of energy involved in such effects as the Aurora Borealis.

THE GRAVITATION NULLIFIER.

(*Continued from page* 251.)

ing together, drifting as aimlessly as thistledown and all shrieking in terror. Guns and wagons were overturned or wafted away by maddened, frantic teams. The whole line as that gyroplane passed over it went into such confusion as only a terrific tornado could have caused.

Cawthorne swept ahead, his orders being to block the railroad. As he passed over the yards at Caliente and put the nullifier into action switching engines lost their traction and either spun their driving wheels uselessly or wobbled off the tracks, piling great loaded cars against each other like bales of cotton-batten. G.N.2 was less than half a minute gliding back and forth over that yard, and it took the enemy four days to restore working conditions.

On again, down the line, stalling the first train but allowing the hundreds of tons

weight of the following train to crash into the first. On again, through the Vegas Canyon, where a half-gale of wind distributed feather-weight moguls and freight cars up along the jagged, precipitous rocky sides of the mountains. Another train of 17 coaches loaded with troops fluttered away—all coupled—across the St. Piedras divide, where it straddled the summit, lying on its side. But, except for some wrenches and sprains, not a man was hurt, for there was not an ounce of weight in the entire outfit, men or cars.

On again, across the wild, arid Tepeguaras plains, where they sent 3,000 of Cabellero's Mexican warriors and horses fluttering in the air like dead leaves, and howling to every saint in the calendar—and many who are not there—to save them. On again, over the Allies' headquarters, where the Jap general, Kioki, and his Chinese ally, Lu Kien, were wafted from a council of war, clinging tenaciously to their camp seats, the Jap settling with sadly ruffled dignity on the flat roof of a 'dobe ranch house, the Chinese drifting against the gyroplane, which had circled down to 400 feet, and where welcoming hands stowed him in the frame—a prisoner for General Illington.

In advance of the G.N.2 flew two aeroplanes, from which were dropped the attractor pellets whenever they came in advance of a train or passed an occupied siding. Then, as Cawthorne followed, his nullifier threw those trains into most appalling confusion. At Mirau Nuevas the operation of this influence, helped by a strong breeze, lifted and deposited an enormous ore bin and the terminal machinery of a great aerial cableway along the main line tracks. In four hours the G.N.2 had blocked 300 miles of railroad at over 40 points.

They turned back, following a direct air line over the mountains to Illington's headquarters. Cawthorne reported amid deep and fervid congratulations, and then laid off for a rest. For nearly 60 hours his head had not touched a pillow.

Six hours later—it seemed but six minutes to him—Capt. Berger came to the tent and aroused him, with the news that the general had received an important dispatch from Washington and wished to see him.

"Captain!" exclaimed the general as Cawthorne half staggered into the room, "I felt it necessary to inform you of this at once." He held out a dispatch:

"To Brig. Gen. N. C. Illington, in command of the Fifth Division at Montova:

"Your report on the work of the Cawthorne nullifiers received. Hearty congratulations. It is advisable that immediate action be taken against the enemy's transports and battleships now in the Gulf of Mexico. You will detail Capt. Cawthorne and his party, with ample escort, to proceed to the Gulf and report to Admiral Young for operation against those ships.

"By order of the President.

"JOHN J. SMITH, Secretary of War."

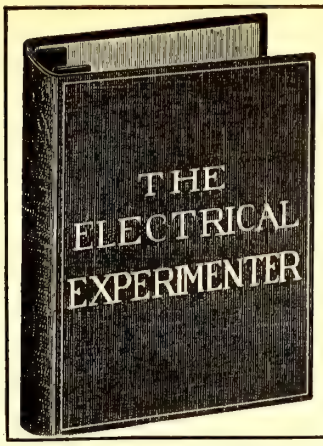
Cawthorne stared blankly and muttered: "Impossible, general! The nullifier can operate only on land. We have not discovered why, but we know that water is a perfect insulator against the electric zone which counteracts the gravitation. The attempt would be useless! The Navy will have to be depended on to clean out the Gulf—unless—"

"Unless what, captain?"

"Unless I can at once go North to my experimental shops. Did you ever hear of the Poniatowski Arc, sir?"

"Never!"

Cawthorne smiled grimly. "I think that



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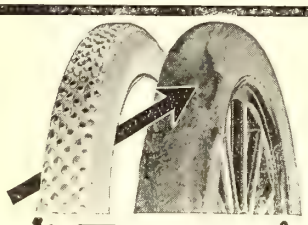
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not one man in a thousand has, although it was discovered several years ago, but suspected only of capabilities for long-distance signaling. "But"—his voice sank into very low, earnest tones—"I know that with the apparatus we have completed in our shops you on land or an admiral at sea would have as full control over the firing of the enemy's guns as the enemy himself has!"

The general dropped back in his chair. "What! Another ghastly invention?"

"Exactly! If I can have leave of absence for ten days—perhaps a little longer, and take Kilroth with me, I think that I can bring you the power to not only countermand every order of the enemy's commanders, but to issue the orders yourself with the certainty that they will be obeyed. The gyroplanes and nullifiers will be here to use if needed again, and Capt. Berger is fully capable of handling them."

The general grunted hoarsely: "I've got to believe you, Cawthorne! I've got to! Your passports shall be made out at once!"

(*The End.*)

A POWERFUL ELECTRO MAGNET FOR BATTERIES.

(*Continued from page* 272.)

N. and S. poles. When the current passes around the coil in a *clockwise* direction (i. e., right-hand), the magnetic pole produced is a South one in a direction toward the reader. Every magnet has two poles of opposite polarity, no matter how small it may be. Unlike magnetic poles attract each other and, conjointly, like poles repel each other, as indicated at Fig. 3 B, where the S. pole of a magnet is attracting the N. pole of the magnetized steel compass needle. The end of the compass needle that points toward the north magnetic pole of the earth is, strictly speaking, the "north seeking pole," or the actual "south" pole of the magnetic needle, as only unlike poles attract each other.

WITH THE "AD MAN."

Along about the time when as a boy I first became a reader of magazines I can remember how people looked upon the ads. found in them. My dad used to tear the advertising pages out and occasionally use them for shaving paper, but most times the stove would get them. Those days when mother saw a department store "ad." she always remarked, "Well they say it's worth $2.50, but I'll bet it isn't worth even as much as they ask, and Lord knows the price is low enough." Those were the views, and the result was that advertising didn't pay as well as to-day, for the confidence of people was lacking, due, of course, to the belief held by many advertisers that people wouldn't believe all they said on paper anyhow, so they had better exaggerate a bit. Well, they did exaggerate all right, but most of them forgot when to quit.

It's different to-day. When Ma sees an ad. now in a good magazine and it looks as though a real bargain is advertised, she sends right off for it, because she realizes that no good magazine would think of carrying the advertisement of a non-reliable concern. Therefore when you see an advertisement in *The Electrical Experimenter* you need have no compunction about sending an advertiser your money, for the publishers of *The Electrical Experimenter* absolutely and unquestionably guarantee the integrity of every advertiser in his dealings with their subscribers.

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We reserve to ourselves the right to refuse any advertisement which we consider misleading or objectionable. Advertisements for the November issue should reach us not later than October 5th.

The Classified Columns of "The Electrical Experimenter" Bring Positive Results.

TO SELL — One telescope, 3 feet long, special lens, good condition. Premo camera, pictures 2½x 3 in.; guaranteed; cost $1.50. Both for $1.55 prepaid. Richard Gaillard, 1719 Pendleton St., Columbia, S. C.

I WILL TRADE a complete wireless set, consisting of the following articles for an Indian or Harley Davison motorcycle of late model and in good condition: Loading coil, receiving transformer, 3 detectors, potentiometer fixed condenser, 2 variable condensers, spark coil, gap key, magneto, Holtzer-Cabot receivers, telegraph key and sounder and a 32-cal. revolver. Address Herbert Ewing, Point Marion, Pa. Box No. 62.

HAVE complete wireless set, racing bicycle, miscellaneous electrical goods, two revolvers. Want motorcycle, or make offer. Will also sell separately. All correspondence answered. Maurice Gelb, 74 East 116th St., New York City.

FOR SALE—Wireless outfit. Has single slide tuner, electrolytic detector, peroxide detector, condenser, two-point detector switch, potentiometer. Mounted and connected. Price, $6, or will sell parts separately. Box 84, Newburyport, Mass.

WILL EXCHANGE—$5 Seneca plate camera for spark coil or dynamo. Write to Elmer Dries, 205 S. Market St., Shamokin, Pa.

OLD jump spark coil, telephone generator and receiver, home-made tuning coil, Popular Mechanics 1913, lithograph locomotive model. Will sell or exchange for wireless goods. Ralph L. Kunan, Sabula, Iowa.

FOR SALE OR EXCHANGE—New $7 electric microscope, projector; guaranteed; ¾-inch coil, wireless key, loading coil with switches; $3 Murdock variable, spark gaps, powerful battery motor, excellent portable receiving set, stamp collection 1,000 rare varieties. Want Brandes Transatlantic phones and wireless apparatus. Write D. Goodman, 118 Seventh Ave., McKeesport, Pa.

WILL EXCHANGE—A 1-K.W. closed-core, high voltage transformer and cash for a Type "D" receiving transformer, De Luxe or Blitzen tuner. All correspondence or propositions answered immediately. John B. Hawley, Jr., 912 College Ave., Fort Worth, Tex.

WILL SELL—3,000-meter mahogany, factory-made loose coupler, new type S Dynamo-Motor cheap; Gravity cells, variable condenser printing press motors; can use spark coil. Write anyway. Carl Barnckol, 2317 Milwaukee Ave., Chicago, Ill.

FOR SALE OR EXCHANGE—$45 E. I. wireless goods, shotgun, 8-volt dynamo, 400 exposure kodak, Oliver typewriter, Electric vacuum cleaner, 8-inch fan, Moving picture camera and outfit. Verner Hicks, Marion, Ill.

FOR SALE—$17 takes Blitzen receiving set in perfect condition, without phones. If interested write Chester Fuss, Little Valley, N. Y.

FOR SALE—Fleming valve detector, new, $3, cost $6; 1-inch Bulldog coil, with extra large platinum points, $2.50; No. 9260 Sending condenser, $1.50; Polarized relay, 50 ohms, $2.50. Everything good as new. Max Kuhne, 94 River St., Hoboken, N. J.

FOR SALE—¼-inch Spark Coil, $1.35, postpaid; Spaulding single end punching bag cover, 50c.;; both good condition. Paul S. Potter, Riceville, Iowa.

WILL EXCHANGE—New three slider Tuning Coil, 8 x 12 inches, tested for Arlington, for services any live boy can render. For Sale, slightly used ½-kilowatt "Blitzen" transformer. Lloyd Gress, Pitman, N. J.

WHAT have you to trade? Join my Bureau of Trades. Have over 500 members; trades arranged anywhere. Send for full particulars. 3820 Lee Ave., St. Louis, Mo.

TYPEWRITER—Cost $100. Good as new. Will exchange for $18 Camera, Electrical goods, Books, Mail-order Goods, Musical Instruments, Athletic goods, Bicycle, Automobile Accessories; $18 Cash, or Offer. What have you? Write. Particulars FREE. H. Victor King, Box 3461, Boston, Mass.

FOR SALE—Clapp Eastham Ferron Detector, $5; Manhattan tubular condenser, $3.50; Brownie No. 2 Camera, $2; or what am I offered? Wm. Matthews, care Walbridge & Co., Buffalo, N. Y.

FOR SALE — $15.00 Murdock loose coupler, primary rewound with 140 turns and tapped to two ten-point switches on hard rubber plate. Worth $20; will sell for $10. Murdock tuning coil rewound as 2,000 meter loader with nine-point switch, sliders removed; $2.50; $18 case of Dietzgen drafting instruments; good as new; $7.50. Edwin L. Powell, 1206 E. Capitol, Washington, D. C.

EXCHANGE—One complete wireless receiving outfit. Want canoe or gasoline engine; prefer motorcycle engine, or what have you? All letters answered. Randall O'Brien, Louisiana, Mo.

FOR SALE — Brand new wireless outfit instruments; never used. For particulars, write L. J. Becker, P. O. Box 339, Galveston, Tex.

WANTED—E. I. Co.'s ½ K.W. transformer coil No. 8060. Must be in good condition. Write. Lloyd Copp, Center, Ind.

HAVE $9 worth of American model builder. Would like good loose coupler, or what have you? William Collins, Gran Ville, Mich.

FOR SALE—X-Ray tube in good condition; dia., 4 inches; will sell for $2.75 prepaid; also step-down transformer, $3 prepaid. Write C. A. Barley, 708 Dolphin St., Baltimore, Md.

FOR SALE—Name plates, battery, shunt, phones, aerial, ground, on, off; 2c. a piece. Henry G. Aschbrenner, 7617 Carpenter St., Chicago, Ill.

WOULD like to purchase, second-hand, a Ritchie induction coil; 4 in. or 5 in. spark; good condition. Apt. 9, 2103 N St., N. W., Washington, D. C.

FOR SALE—1,200 meter, loose coupler, $2.25; ½-inch coil, $1.50; fixed condenser, 25c.; plate condenser, 35c.; upright detector, 60c.; Simplex typewriter, 60c. C. Stanley, 405 Jersey St., Buffalo, N. Y.

FIRST REMITTANCE of $1 gets a coherer and decoherer complete; never used; postpaid. Instrument worth $2 when new. Wm. D. Wagner, 123 W. 4th St., Duluth, Minn.

WILL EXCHANGE—A 6-volt, 80-ampere Williard storage battery for polarized relay or phonograph, or what have you? Samuel Cohen, 1936 Pitkin Ave., Brooklyn, N. Y.

FOR SALE—A Baker electric coupe in first-class condition with new batteries; three passenger. On account of illness of owner, will sell at bargain price of $500; cost new, $3,200. S. Gernsback, 817 West End Ave., New York City.

WANTED—One Bulldog 1 inch or 1½-inch Spark Coil. I. Wiley, 1214 E. Madison St., Portland, Ore.

FOR SALE—Resonator, 75c.; Potentiometer, 75c.; Helix, 75c.; Variable Fixed Condenser, 75c.; Fixed Condenser, 25c.; Galena Detector, 50c. Leighton Gilbert, Bristol, N. Y.

FOR SALE—A complete wireless sending and receiving outfit. Cost me $40. Will send for $20. For complete list of instruments send to following address: Horace Hinz, 327 Old Bergen Road, Jersey City, N. J.

FOR TRADE OR SALE—Good D. C. Fan, fourth K. W. Transformer, fine Alto Saxophone, Revolver, etc. Will trade some of these for a good Microscope. Also want Camera, Storage Battery Motor, X-Ray Outfit, etc. Send your list and make offers. L. Smith, Oak St., Ashland, Ore.

BARGAIN—Daily Life of a Railway Mail Clerk, Modern Business Penmanship, New Commercial Arithmetic, Civil Service Manuals 1, 2 and 3, $3 takes entire lot. Mark Kistler, Centreport, Pa.

FOR SALE—1 De Forest Audion Detector (with new bulb and batteries), $15; an E. I. Co. 5,000-meter loading coil, $1.50; Fixed variable condenser, $1; oscillation transformer, $5; a pair of 3,000-ohm "Government" phones, $5; Variable condenser, $2; a Bunnell Mascot Rotary variable condenser, $6; a 5,000-meter navy type loose Coupler, $5. These instruments are in first-class condition. Other apparatus on application. If interested write George D. Todd, Jr., New Albany, Ind.

HAVE one 110-volt D. C. Fan Motor, one A. C. 110-volt, 125-cycle "Emerson" Fan Motor, one Volume of "Practical Electricity and Engineering" and four volumes "Electrical Review and Western Electrician" and some cash. Will exchange for any first-class wireless apparatus; want phones and Audion Detector. What have you? John Kidd, 421 Leslie Ave., Niles, Ohio.

READERS — I want the following magazines: Popular Electrics, 1908, from beginning to September, 1909; January Bubiers Nat. Electrician, 1906; June Elec. & Mechs., 1908; January, 1909; April, 1911; October, 1912; August Elec. Experimenter; 1913, January to April; 1914, January and April. For these will give 40 Elec. Mag., 2,000-ohm headset, or cash. Harold E. Hickey, 1435 Howard St., Philadelphia, Pa.

NAVY Type Loose Coupler; new; $8. Also complete portable set. What have you to exchange? Hathaway, 856 Fulton St., Brooklyn, N. Y.

FOR SALE OR EXCHANGE—Westinghouse step-down transformer, type A, 10-volt amperes, 60 to 133 cycles; in A1 condition. Will exchange for Type O Crystaloi, or 2-inch coil. W. Beattie, 517½ Chestnut St., Lebanon, Pa.

FOR SALE—Two good electric motors in first-class condition; 1-12 horsepower, $5; 1-6 horsepower, $8; 800 feet of good comedy moving picture film, $4. H. David, 711 S. Kedzie Ave., Chicago, Ill.

I WILL EXCHANGE a high-grade cornet for a half or quarter K.W. wireless transformer. Have a lot of copper ribbon for sending transformers. Will sell it out at 3 cents per foot. Henry Graves, Jr., Geneva, N. Y.

SALE OR EXCHANGE—One Weeden toy motor; 1-20 ohm sounder; 2-50 ohm relays; 1 small Leyden jar; 1 D.P.S.T. switch; 1 voltmeter; 1 telephone transmitter. Alexander V. Bollerer, 77 Linwood St., New Britain, Conn.

WILL SWAP electrical chemistry and books on physics for anything useful. Henry Priebe, Kent, Ohio.

WANTED — One-inch spark coil and gap; good condition. Have electric engine and car, 80 feet track; one railway switch; same as new; value, $9. L. D. Smith, 28 Poinier St., Newark, N. J.

EXCHANGE — A Gem adding machine in good working condition; cost $10. Want a pair Brandes Transatlantic phones or a good 110-volt Universal motor speed range from 3,000 to 8,000 r.p.m. with load. O. W. Nelson, 4333 Elm St., Calumet, Mich.

FOR SALE—Two one-inch coils, $2.50 each; two small motors, 50c. each; quarter-inch coil, 75c. Moershfelder, 34 Ketchum Pl., Buffalo, N. Y.

FOR SALE—Four H.P. Excelsior motor cycle engine with carb., $15; 4 H.P., 2 cycle, 3 port engine; use as stationary, marine or portable, with carb. coil-less oil cups; used very little; $25; one set cycle car wheels, axles, tires and tubes, set of steel castings for four cantilever Krupp springs, $60. For further description, E. W. Jenny, 3821 W. 34th St., Cleveland, Ohio.

FOR SALE—Complete Wireless Outfit. Consists of double slide tuner, condenser, potentiometer, detector, buzzer, 1,000-ohm receiver, 1½-inch coil, fluted zinc gaps, helix, condenser and key. All mounted on suitable base. No home-made instruments. $6. Portable receiving set, consists of loose coupler, galena detector, condenser; all in good case, $2.50. Motors, telephones, cameras, aerial and magnet wire. Write for particulars or send money. Everything guaranteed. Paul Woodward, Rodney, Iowa.

WANTED—2,000-ohm headset, or one good loose coupler. Have relay marked 200 ohms and sounder marked 20 ohms. Will trade for any of the above, or will sell cheap. Wilber E. Dittemore, Redmond, Ore.

SALE OR EXCHANGE—Complete wireless set, consisting of 1-inch coil, helix, gap, condenser, key, aerial switch, double slide tuner, galena detector, receiving condenser, single headset, Brandes 1,000-ohm receivers, binding posts. Will either sell or exchange for Audion or Variable condensers. Jeter Pinkston, Valdosta, Ga.

EXCHANGE—Murdock Tuner, variable, cash for ½ K. W. condenser; also other apparatus to exchange for good transformer. Give description to Arthur Sacka, 2670 E. 40th St., Cleveland, Ohio.

FOR SALE—Large Electro tuner, $1.75; variometer, 50c.; 11-plate variable condenser, 75c.; 9-volt rotary gap (8 electrodes), $2.50. All instruments in excellent condition. Stuart W. Pierson, Carrollton, Ill.

"HYTONE"—½ K. W. set for sale; condition excellent, price very reasonable. This apparatus, operating station 1HA, now 1ZW, has covered remarkable distances. Record, 650 miles. Come and inspect apparatus personally if possible; if not write for photo and description without delay. Have just installed more powerful set. Wm. H. Allison, Worcester, Mass.

A COMBINATION 4 x 5 or 5 x 8 Plate Camera (Tripod, one French and one Morrison Wide Angle Lens (each cost $25), Plate Holders, carrying cases, etc.; a bargain. W. E. Day, Pittsfield, Mass.

I HAVE 3 transmitters, 2 ringing boxes, 2 telephone receivers, 1 desk telephone, 1 Edison Primary battery, 1 telephone generator worth $25. Will swap for wireless set or apparatus. R. C. Bayley, 16 Main St., Plymouth, N. H.

FOR SALE—Set Ives Electric Train, 3 pieces; 8 Curve, 10 Straight, Third Rail Track, practically new, worth $6, will sell for $3.50. H. Ananiantz, 700 West Washington, Los Angeles, Cal.

WANTED—A 2,000-ohm double headset, each receiver 2,000 ohms. R. B. Watt, Box 1, Stapleton, N. Y.

FOR SALE OR EXCHANGE—Rotary Spark gap to work on dry batteries, Geissler tube, Harper's Aircraft Book, Spark gap, set of Meccano No. 3, Carl Seternfeld, 305 Lexington Ave., New York.

FOR SALE—Omnigraph Dunduplex transmitter, sounders, relays, keys, aerial insulators, small motor, tape transmitter and wireless goods. Write for list. John L. Bowman, Reinholds, Pa.

FOR SALE—$14 electric railway, $5; $2 omnigraph, $1; $6 worth Magic, $3.50; two $2 stamp albums, $1 each. For particulars write Franklyn Stratford, Bentley Ave., Jersey City, N. J.

FOR SALE—2 Electrolytic Detectors (new), $1 each; 1 Three Slide Tuner, $2; 1 Toy Motor, 50c. All in perfect condition. Miles F. Ham, 21 Crosby St., Augusta, Me.

FOR SALE OR EXCHANGE—160 Watt set, value $15; 400 watt impregnated condenser, $8; Davis battery motor, $4; Stevens single-shot rifle, $7. Write for list. Money or transmitting apparatus wanted. Make offer. H. Smeltzer, Norwood, Mass.

ELECTRICAL—35 K.W. Westinghouse Alternator, right for a small town plant, $300 in payments of $20 per month. 18 K.W. 220 volt direct current generator will carry 900 regular 16 candle Tungsten lamps, $200 in payments of $15 per month. 16 cells storage battery in good condition $35. Electric Bath Cabinet $25. Box M, Troy, Ohio.

FOR SALE OR EXCHANGE—Stevens' "Favourite" 22 cal. rifle, value $3; will trade for Crystaloi or Radioson Detectors. Gartz Windenburgh, Lamont, Iowa.

EXCHANGE—Brass upright Microscope, $1.75; Kodak, Premo Jr. No. 1, 2¼ x 3¼, $1.80. Want Loose Coupler, not home-made. Porter Bennett, Mesquite, Tex.

FOR SALE—½-H. P., 110-volt A. C. motor, $27.50. Will buy or trade 2-inch coil. C. P. Kelley, Irving, Ill.

FOR SALE—4 x 5 print washer, used once; two 8 x 10 trays, dark room lamp, Drake's Multiple Picture attachment, size 4 x 5; acetylene bicycle lamp; Year 1913 Scientific American, Spaulding's Note, Speller. Write for description and prices. Donald L. Zook, Denver, Ind.

FOR SALE—First-class wireless set at moderate price. Write for particulars. Gogerty, 210 Reid Ave., Brooklyn, N. Y.

FIRST MONEY ORDER for $10 takes either my 16-V. dynamo or ¼-H. P., 110-V. D. C. Motor or 1-H. P. Gas Engine. Maurice Lane, Geneseo, Ill.

FOR SALE—One Electro Loading Coil, $1.75; one Electro Loose Coupler, $2.25; one No. 2 Brownie Camera, $1.60; all for $5. Merwin Finkelstein, 308 Eddy St., Ithaca, N. Y.

FOR EXCHANGE—Eastman folding kodak, Medical Coil, Stepdown Type "N" transformer, cost $4; Electro and Delta electric bicycle lamps, Book "Practical Electricity," cost $2; two electro magnets; all goods new; value $23. Exchange for good wireless receiving set. Write and tell what you have. Ray M. Casper, 621 E. Innis St., Salisbury, N. C.

EXCHANGE—Variable Condenser for Telegraph Instrument, Switch Block, Silicon Detector and Fixed Condenser for Telegraph Instrument; Murdock Spark Gap and Buzzer for same. Harold Bonney, 103 Spruce St., Pana, Ill.

EXCHANGE—Solar bicycle lamp, cost $2.50, for water motor, standard thread faucet. B. Bergman, 120 N. 109th St., Chicago, Ill.

FOR SALE OR EXCHANGE—Loose Coupler, tuners and other wireless apparatus; have a number of pieces. Make offer. William Lesky, 2800 Snyder Ave., Philadelphia, Pa.

FOR SALE—Entirely new pumping outfit, 1½ H. P. engine, 10-foot belt pumpjack, $26; good coaster brake bicycle, $9. Frank Fish, Geary, Okla. R 1.

FOR SALE OR EXCHANGE—One Spark Gap mounted on marble base, 50c.; one Cat Whisker Detector mounted on slate base, 60c. R. A. Clapp, Groton, N. Y.

FOR SALE OR EXCHANGE—One motor and bicycle. Write for particulars. Lloyd W. Cameron, West Collingswood, N. J.

FOR SALE OR EXCHANGE—Sending and Receiving set. All in good condition. Write for information. Anythony G. Jurincic, 9550 Commercial Ave., Chicago, Ill.

FOR SALE—3A Brownie Camera (post card size). It is brand new; has never been used. Price $9, if taken at once. E. Haugerud, Scappoose, Ore.

FOR SALE OR EXCHANGE—Chemical laboratory outfit, nearly 300 pieces; will sell whole or in part. 8 Vol. Cyclopedia, I. C. S. Text-books of Chemistry and Electrical Engineering. Also other books and articles. Sell cheap for cash. Will exchange for suitable articles of equal value. Complete lists exchanged. M. Wand, 118 Crane St., Schenectady, N. Y.

WANTED—Receiving and sending instruments. Transformers from 1-6 K .W. to 1 K. W., Variable condensers, etc. Have one set of six books of the Practical Reference Library (fine), Automobile course, rifle, relay, omnigraph, story books, camera, revolver, home-made voltmeter, ammeter, galvanometer, Wheatstone Bridge and old magazines. Walter Franseen, Woodhull, Ill.

WANTED—Crystoli detector and variable condenser by September 20 for portable set (2-switch navy type tuner, detector and condenser), moving picture machine (electric), value $4.50; ¼-inch spark coil, in excellent condition. Thomas Steringer, 260 Hudson St., New York.

FOR SALE—Duck's new 1915 Detector with silicon, 1 New Rotary Spark Gap; never been used. All for $5 cash. M. H. Chapman, Baldwinsville, N. Y.

HAVE ½-inch Coil, zinc Gap, strap key, 4-plate condenser. Trade for loose coupler or Brandes receiver and Double headband. Garwood, 84 King East, Toronto, Canada.

WANTED—To buy a few Geissler or vacuum tubes, also an X-Ray tube. Albin Lundquist, Cable, Wis.

EXCHANGE—One Companion Lathe and Scroll saw in good shape, price, new, $8.50, for 2-inch Spark coil or other electrical apparatus. Leland Jones, Warrensburg, Mo.

Advertisements for November issue should reach us not later than Oct. 5.

Opportunity Exchange

Rate is 4c. per word, name and address to be counted.

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YOU

Never will be able to understand yourself, much less GOD'S PERPLEXING WAYS, nor a great many other problems of LIFE and AFTER-LIFE, unless you read the results of thirty years' investigation by Erardus Sagra, entitled "THE MIGHT OF TRUTH"; a production **in as concise a form as possible**; not based on imagination or possibility (called hypothesis) but on plain self-evidence; **written in popular language**; and, so far, not refuted by the most eminent men of science or religion, for the simple reason that they learned the Truth, which in itself is Divine. A progressive reader says: "You do not know how much help and satisfaction the results of your investigations gave me." Another reader said: "Your production 'THE MIGHT OF TRUTH,' is the most beautiful book I ever read." **Index and first 4 pages Mailed Free on application**; and if you save this copy of THE ELECTRICAL EXPERIMENTER you can save 50c. (the retail price is $1).

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BOYS—Make a small electric stove; easy to make; uses ordinary house current; dime for complete directions. Richard Gaillard, 1719 Pendleton St., Columbia, S. C.

FORMULAS

INKS—8c., 4-25c. P. Waldie, 21 Woodbury, Beverly, Mass.

FREE—Six valuable formulas. Easy to make—metal polish, "Resisto" cement, transparent soap, washing compound, eczema treatment, complexion beautifier. Send 2c. stamp. Daley & Meyer, 688 President St., Brooklyn, N. Y.

HOW to nickel plate. Formula, $0.50. E. F. Ball & Co., Buckland, Conn.

FOR INVENTORS

DRAWINGS made for inventors. Consulting Engineer, EE-3240 Seminary Ave., Chicago.

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MISCELLANEOUS

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A POWERFUL oxy-hyd. dissolving view stereopticon outfit capable of making a 40-foot picture; complete with lecture sets and large assortment of colored dissolving views; a rare chance to get a large outfit at small price. W. E. Day, Pittsfield, Mass.

FREE DEVELOPING—Postcards, prints, 2c.; 8x10 enlargements, 20c.; coin. Emil Sprauer, Hamilton, Ohio.

25 POST CARDS—No two alike; 10c. Chas. Phildius, 510 East 120th St., New York.

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MODELS, dies and manufacturing for inventors, by builders of "Tools That Work." La Croix Tool Co., 214 N. 21st St., St. Louis, Mo.

MODELS

GASOLINE and Steam Engines, 1-10 to 10 H.P. engine castings. Dynamos and motors, 1-30 H.P. up. Complete electric light plants, $35. Send stamp for Bulletin 105. Dynamic Manufacturing Co., First National Bank Bldg., Chicago.

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PATENTS without advance attorney's fees. Not due until patent allowed. Send sketch for free report. Books free. Frank Fuller, Washington, D. C.

PATENTS SECURED OR FEE RETURNED. Send sketch or model for free search and report. Latest complete patent book free. George P. Kimmel, 254 Barrister Bldg., Washington, D. C.

DON'T LOSE YOUR RIGHTS to patent protection. Before proceeding further, send for our blank form Evidence of Conception to be signed and witnessed. Book, instructions and advice free. Lancaster & Allwine, 242 Ouray Bldg., Washington, D. C.

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STAMPS, 100, ALL DIFFERENT, FREE—Postage 2c. Mention paper. Quaker Stamp Co., Toledo, Ohio.

WIRELESS

$10.00 Commercial Keys for $4. Money refunded if not satisfied. Massie Wireless Telegraph Co., 77 Washington St., Providence, R. I.

LOOSE-COUPLED receiving set; uses switch-points; wave length, 5,000 meters; will receive Arlington 1,000 miles; price, $5. E. F. Ball & Co., Buckland, Conn.

RADIO queries answered fully and promptly; 3 for 10c.; 8 for 25. J. L. Green Radio Information Bureau, Rosser, Man.

GALENA DETECTOR—Marvelously sensitive; no adjusting; cannot burn out; lasts indefinitely; only 35c. H. Gerrodette, 1043 East 17th St., Brooklyn, N. Y.

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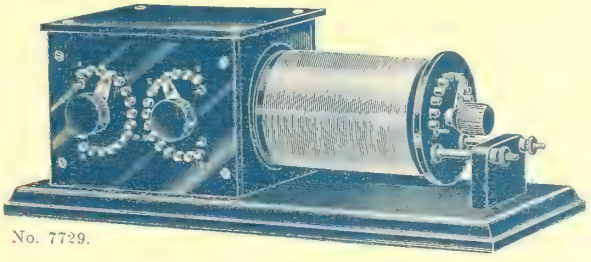
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Represents the latest advances made towards the ideal tuner and embodies the greatest degree of perfection yet obtained. No greater value can be secured where accurate selectivity, sensitiveness and finish are desirable. The illustration shown herewith cannot possibly do justice to the instrument itself. The primary winding is enclosed in a cabinet, the sides and top of which are polished hard rubber. Two 15-point switches are mounted on the front. One switch controls the primary in groups of several turns and the other controls one turn at a time. The entire variation of the primary is thus secured by the rotary motion of two knurled knobs rather than the movement of a slider, and may be varied from **1 to 225 turns in steps of one turn at a time.** The windings are especially adapted to long wave lengths. The secondary is wound with green silk covered wire. The ends are HARD RUBBER, turned and polished. Secondary variation is secured by a 12-point switch which makes it possible to secure a very fine adjustment. **PRICE, ONLY $15.00.**

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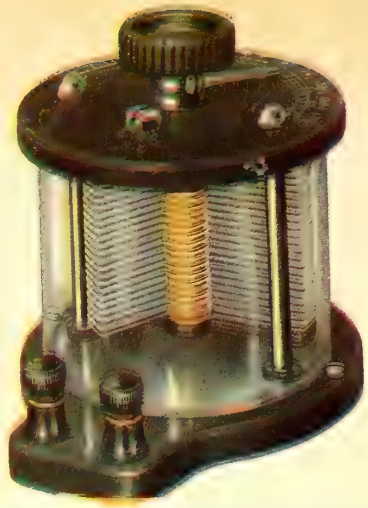
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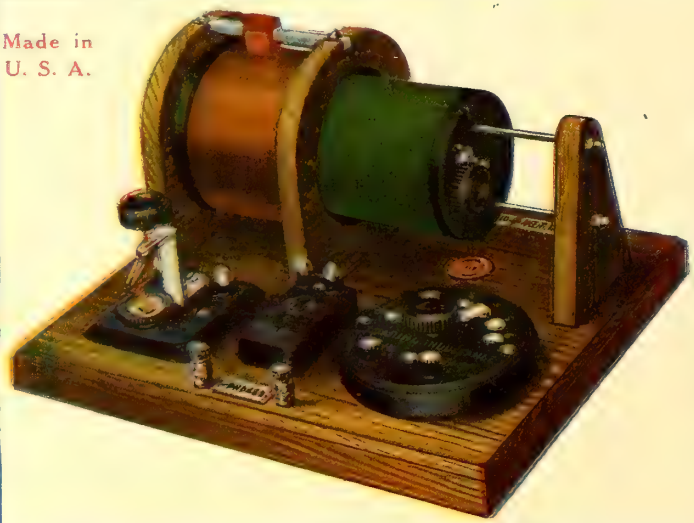
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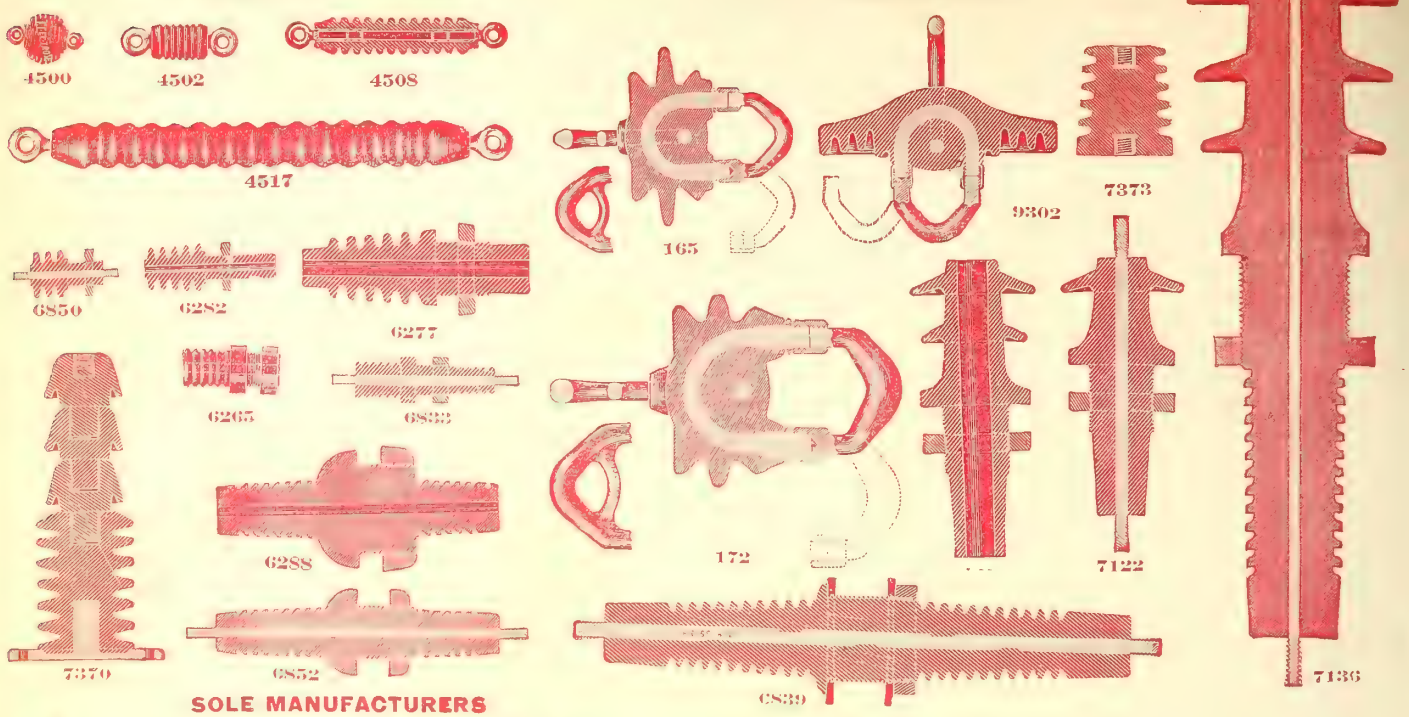
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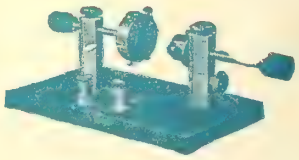


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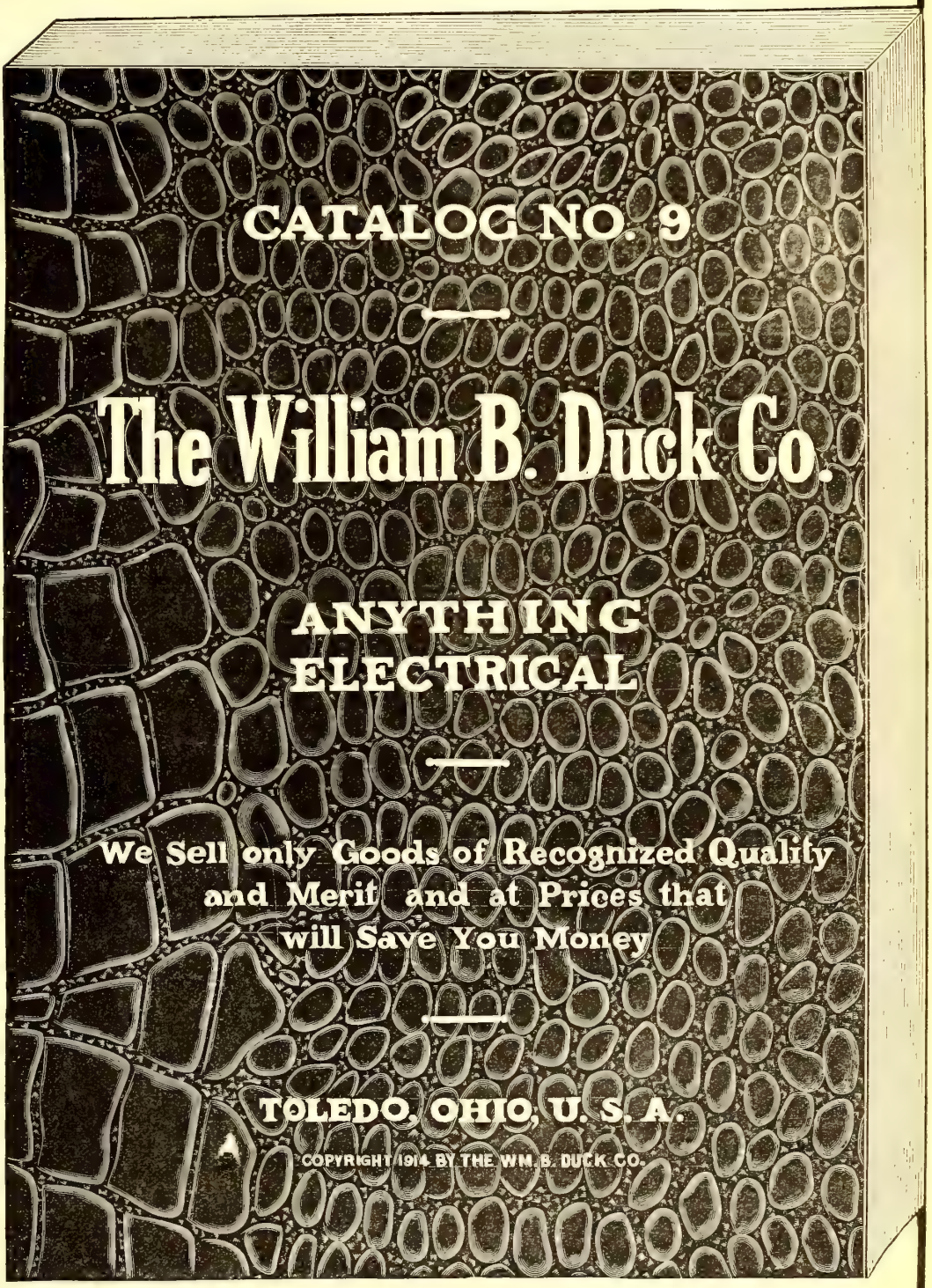
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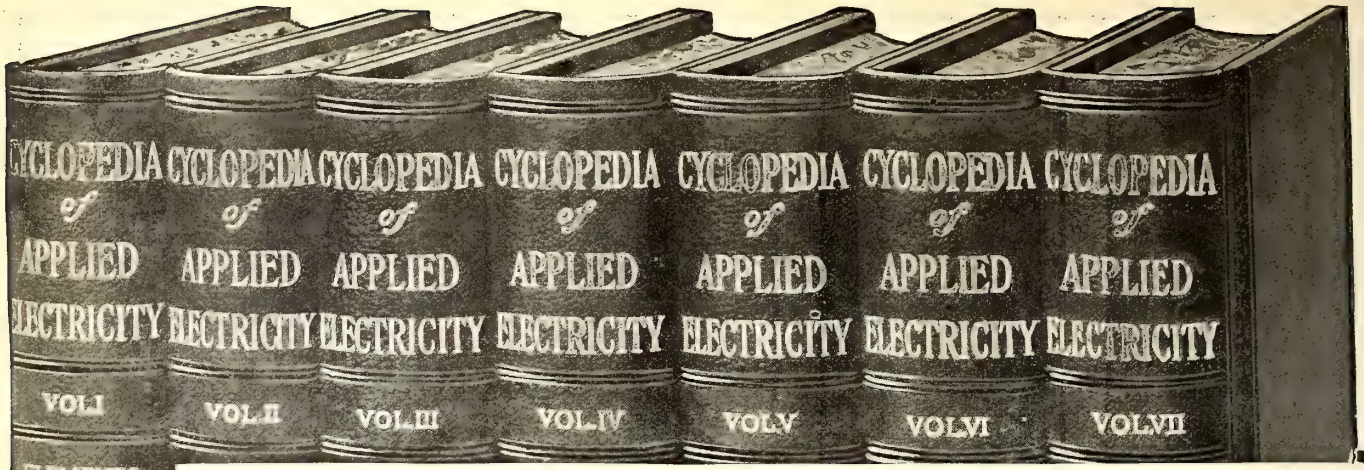
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Vol. III Whole No. 31 CONTENTS FOR NOVEMBER, 1915 No. 7

FRONT COVER—"THE RADIUM DESTROYER"..... From a Painting by Thomas H. Wrenn —
THE ELECTRO-MAGNETIC GUN AND ITS POSSIBILITIES... 309
BARON MUNCHHAUSEN'S NEW SCIENTIFIC ADVENTURES. By Hugo Gernsback 312
WARFARE OF THE FUTURE..... 315
WHEN THE LIGHTS WENT OUT ON THE "BELLA"..... 316
WHAT THE HOUSEWIFE SHOULD KNOW ABOUT ELECTRICITY 317
SOMETHING ABOUT SELENIUM.....318-320
WIRELESS TELEPHONY NOW FROM WASHINGTON TO HONOLULU 321
PHOTOGRAPHING SOUND WAVES ELECTRICALLY.....322-323
DANIELS NAMES NAVAL BOARD..... 323
SOME NEW X-RAY APPARATUS..... 324
READING ELECTRIC METERS WITH A CAMERA..... 326
MISHAPS ATTEND USE OF WIRELESS ON AEROPLANES... 326
MASSIVE ELECTRIC GENERATOR HOLDS AUTOMOBILE..... 327
MIND-READING DOG IS A PUZZLE TO SCIENTISTS..... 327
HIGH FREQUENCY CURRENTS AND APPARATUS..... By H. Winfield Secor 328-329
STEPPING STONES FOR JUNIOR ENGINEERS..... 330
AUTOMATICALLY CONTROLLED ELECTRIC OVEN FOR TESTING SHRAPNEL 331
ILLUMINATED STEAM CURTAIN GIVES WONDERFUL EFFECT AT NIGHT..... 332
ELECTRICITY AND THE TWENTIETH CENTURY DENTIST.. 332
"THE CONSTRUCTOR" DEPARTMENT 333
HOW TO BUILD A DICTAPHONE DESK SET..... 333
CONSTRUCTION OF AN INDUCTIVE TUNER..... By Milton B. Sleeper (Conclusion) 334-335
"RADIO" DEPARTMENT 337
THE AMATEUR RADIO STATION WHICH AIDED UNCLE SAM.....By Charles E. Apgar 337-338
A POCKET WIRELESS SET..... 338
A MACHINE THAT CAPTURES AND HOLDS WIRELESS TALK 339
HOW WIRELESS WAVES TRAVEL AROUND THE EARTH'S CURVATURE 340
HOW TO BUILD A WAVE METER.....By Samuel Cohen 341
"HOW-TO-MAKE-IT" DEPARTMENT 344
"WRINKLES, RECIPES AND FORMULAS"..... Edited by S. Gernsback 347
"WITH THE AMATEURS".....348-349
"LATEST PATENTS" DIGEST..... 350
"PHONEY PATENTS" 351
QUESTION BOX"..... 352
"PATENT ADVICE".....Edited by H. Gernsback 361

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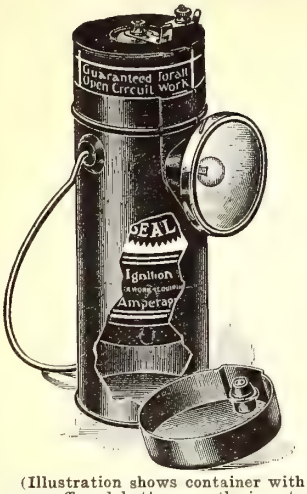
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Truly, while this recent feat has been a signal achievement, we confidently look forward to that time—not far off, we think—when it will be possible to talk from New York to Chicago with a power derived from six small dry cells.

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(Illustration shows container with cover off and battery partly inserted)

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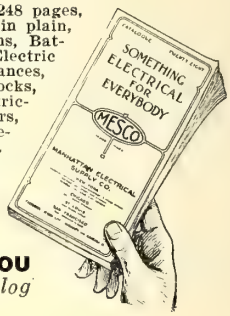
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H. GERNSBACK EDITOR
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Vol. III. Whole No. 31 NOVEMBER, 1915 Number 7

The Electro-Magnetic Gun and Its Possibilities

WHILE we have heard of many different kinds of life destroying guns and other weapons during the present European conflict in all its magnitude, there are probably not many of us who have stopped to think of the possibilities of a somewhat unknown invention which relates to nothing less than the hurtling of large projectiles through space by means of electro-magnetism properly applied to a gun or cannon barrel.

There have been several patents issued on such devices, but to our knowledge none of these have been adopted by any of the world powers. As an introductory explanation reference may be made in this connection to Fig. 1, and undoubtedly the reader will then be able to grasp, with the aid of the following explanatory remarks, about how the various inventors of the electro-magnetic guns intend hurling their projectiles at the enemy with hair-raising rapidity and accuracy.

Referring to Fig. 1, and for the sake of simplicity, we may consider that but three electro-magnetic coils are in use as at 1, 2 and 3 along the gun barrel. It may be said that invariably such a gun barrel should have an inner lining of brass or bronze, so that the projectile which is usually made of a magnetic material (such as iron or steel), will not bind within the barrel. The barrel proper can be made of iron properly divided, but an all-brass barrel is common. Now consider that the three magnet coils, 1, 2 and 3, are connected up to a switch as shown. If, then, an iron projectile is placed in the position A, and the current caused to flow through the coil 1, the electro-magnetic field of force set up within the gun barrel will tend to pull the projectile forward in the direction of the arrow. It should be mentioned before going further that the iron barrel (if used) of the cannon or gun is divided up into several distinct sections so as to localize and intensify the magnetic pull on the projectile at each new impulse.

Of course, this scheme outlined at Fig. 1 is only mentioned to bring out the general theory of how these guns are supposed to operate. To continue: when the projectile has reached the position of coil 1 the control switch is moved so as to cut out coil 1 and to connect coil 2 into circuit. If this is done quickly the projectile will have been sucked forward on a line with coil 2. The operation is again repeated and the switch is moved so that coil 3 will be put into the circuit and coils 1 and 2 opened. Thus the projectile will again be pulled forward to section 3, and at the instant it reaches the center of the *final coil* the current is cut off and the momentum acquired by the projectile is relied upon to carry it on and out of the muzzle of the gun at B. This design is the basis of most of the patents on this unique device, which has yet, we may say, to be proven in a practical sense for modern warfare requirements, although it seems indeed to possess possibilities if the details are properly worked out.

The wash drawing illustration here presented at Fig. 2 shows how we may conduct warfare in the future if the powers that be still think that the only way to settle an argument is by main strength and ignorance. In our illustration is shown a probable development of a large electro-magnetic field gun mounted on a massive iron frame-work fitted with large caterpillar wheels, as observed, so that it is mobile enough to be quickly hauled from one place to another on the battlefield or for siege purposes. When used for portable requirements it will invariably be necessary, if such guns are ever adopted, to provide a complete portable electric generating plant as is shown in the picture. This would comprise a powerful gasoline engine direct connected to a suitable electric dynamo.

Some idea of the probable size of such guns may be obtained when it is stated that one of the best designs ever worked out on this principle, and due to Prof. Birkeland, has a barrel 90 *feet in length.* The projectiles used in this gun would be about 9 feet long and have a diameter of 19 inches. Also to gain the maximum magnetic pull by this arrangement it is recommended that the projectile be wound with coils of wire so as to be electro-magnetically reactive in conjunction with the regular magnetic disc coils placed along the barrel of the gun as perceived. In order to facilitate the passage of the projectile through the barrel of the gun with the least friction we strongly suggest that suitable lubrication be provided by means of grease or oil cups placed along the barrel at intervals; these may be observed in our illustration Fig. 2.

It must be remembered that these guns would not heat to any appreciable extent and not at all compared to the heat produced in the modern high powered guns using explosive charges of powder. Due to this and other obvious reasons such a gun as this can fire a great number of larger caliber shells per minute, possibly fifty to seventy-five shells in one minute. It will be seen from the foregoing that such a discharge of 19-inch shells, each of which contains a very high explosive powder charge, would serve to quickly rout the enemy, no matter how well he might be entrenched or ensconced behind fortified embankments. A rain of such monster shells would batter down almost any fortification whether natural or built by man. A method is suggested in the illustration of this electro-magnetic gun of the future whereby a constant supply of shells for rapid firing can be always maintained before the open breach of the gun. The shells might be hoisted by means of a gasoline engine and run on the platform at the left and then allowed to slide by gravity down the inclined chute. As fast as one of the shells is sucked into the breach of the gun barrel it is followed by another one right after it successively. It is easily possible to have means of firing the shells as far apart, in respect to time, as is deemed advisable, of course. The electric current supplied through the coils along the gun barrel can be controlled through a suitable switch by the man aiming the gun and who may be located alongside of the breach of same as perceived in our illustration.

Such guns as these firing 19-inch explosive shells may have a range of twenty-five miles or more. The shells may carry time fuses, or they may be of the concussive explosion type, whereby they do not explode or burst until they hit the ground or the wall of a fort, etc.

Of course, these magnetic guns are practically noiseless and naturally also absolutely smokeless. Furthermore the wear and tear or depreciation, in so far as the gun barrel lining is concerned, is very low compared with modern cannon and other arms using explosive charges to expel the bullet or shell from the barrel of same. The shells or bullets in such cases must fit very tightly so as to prevent the exploding charge in the gun barrel from leaking out and at the same time to force the shell outward with all available power. In magnetic cannon the shell does not

THE ELECTRICAL EXPERIMENTER is published on the 15th of each month at 233 Fulton Street, New York. There are 12 numbers per year. The subscription price is $1.00 a year in U. S. and possessions. Canada and foreign countries, $1.50 a year. U. S. coin as well as U. S. stamps accepted (no foreign coins or stamps). Single copies, 10 cents each. A sample copy will be sent gratis on request. Checks and money orders should be drawn to order of THE EXPERIMENTER PUBLISHING CO. INC. If you change your address notify us promptly, in order that copies are not miscarried or lost. **A green wrapper indicates expiration.**

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necessarily have to fit the barrel tightly and thus friction can be vastly reduced. Moreover, there is no pitting or other wear on the inside of the barrel, due to powder explosions as just mentioned.

At Fig. 3 is shown a patent issued to S. T. Foster, Jr., (No. 811,913) on an electro-magnetic gun. This patent will serve to give a fair idea as to the general make-up of these devices intended to supplant the modern artillery now in use by world powers. Mr. Foster arranges a series of powerful electro-magnetic coil windings along the non-magnetic gun barrel 11-12. The magnetic projectile made of iron or steel is placed in the breach at 11, just far enough to reach the electric contact 1. When this contact is depressed by the shell it closes the electric circuit through the magnetic coil 15. This causes the shell to be pulled forward, and as the forward section of the projectile then engages the cut-out switch 2, it depresses same and excites the magnet coil 16. The projectile is then pulled forward electro-magnetically until it is in line with coil 16, and simultaneously actuates the cut-out switch 1, which opens the circuit to coil 15. At this instant, generally speaking, the shell in sliding forward into line with coil 16 has engaged the cut-out switch No. 3 and this closes the coil circuit 17, thus the shell is pulled forward into line with that coil and coil 16 is cut out of circuit, owing to the contact 2 having reset itself automatically.

Thus it will be seen how the iron projectile is propagated through the barrel toward the muzzle 12. The operation previously described repeats itself until the shell reaches the position of coil 23, and here it strikes a cut-out switch 10, which opens the current circuit. No magnetic pull is further exerted on the projectile and it leaves the muzzle of the gun under its own momentum. The inventor in this case claims that the shell is supposed to gain velocity repeatedly and successively as it moves from each coil to the succeeding coil. This arrangement for cutting out the coils as the shell moves through the barrel is followed out in several other patents and seems to be a general idea with most of the inventions in this direction.

It would take up too much space here to describe in detail the very ingenious mathematical and engineering deductions cited in the wonderful patent of Prof. Kristian Birkeland of Sweden. In his patent (U. S. Patent No. 754,637) he brings out some very fine points with regard to the development of the electro-magnetic gun. A few of the considerations there advocated,

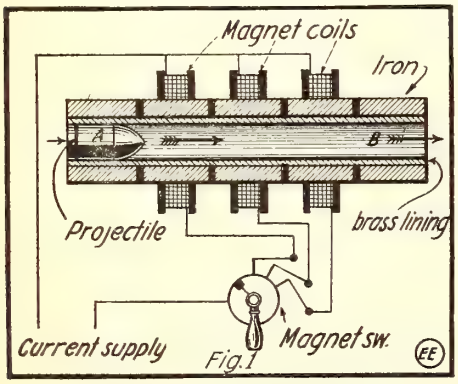


Fig. 1. Elementary Diagram Showing Action of an Electro-magnetic Gun.

hypothetically and otherwise, are outlined below.

In the first place, it has been found difficult to make an electro-magnetic gun of ordinary size which will exert a sufficient pull on the projectile to gain the effects now produced by the modern explosive charge type of cannon. Therefore this inventor proposes to arrange the switches, etc., on his gun so that the current through the coils will only be left on for a very small fraction of a second in any case. Also in considering the regular approved engineering design of such magnetic coils

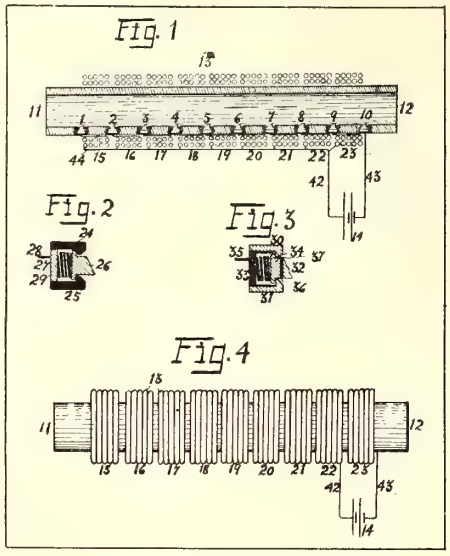


Fig. 3. Electro-magnetic Gun Patent Issued to S. T. Foster, Jr.

he proposes not only to pass a *normal current* through the coil, but a current even *ten times* as heavy, or more, and thereby momentarily (for the fraction of a second), a terrific magnetic pull can be exerted on the iron shell within the barrel. He mentions further (and this is a capital idea) in order to increase the magnetic action in such a gun it is preferable to make the projectile of iron surrounded by magnetic coils instead of iron alone.

Further schemes outlined in Prof. Birkeland's patent cover the arrangement whereby it is possible to open the magnetic coil circuit without any spark occurring at the break of the contacts. This is accomplished by taking advantage of the fact that the projectile moving through the barrel will induce electric currents in the magnet coils and at the instant when this induced current is approximately equal to the current flowing through the coil and which, of course, passes through the coil in the opposite direction to the normal current, then the cut-out switch is operated with no sparking at same.

He goes on to say: "As to the dimensions which may be given to guns constructed according to my invention, the following example may be mentioned: For throwing an iron projectile weighing two tons and containing one thousand pounds of nitro-gelatin at an initial speed of one thousand feet per second I propose the use of a gun with a length of about ninety feet, the projectile being about nine feet long and having a diameter of about nineteen inches. The gun solenoids may be made up of square wire, each solenoid containing seven hundred and twenty windings of a total resistance of fifteen ohms. The length of each solenoid is made about three-eighths of an inch and the height (radial dimension) about eight inches. With an electromotive force of three thousand volts this will give a current of two hundred amperes. If the current is set up simultaneously in all the solenoids (there will be about three thousand elementary solenoids), this will require altogether six hundred thousand amperes, and the suction acting on the projectile will be about two thousand five hundred pounds per square inch of the cross-sectional area of the projectile. A calculation shows that when a firing is to take place the current should be set up one-seventh of a second before the firing. The projectile is then set free, and will pass the barrel in the course of one-fifth of a second. The current has then been on the outermost solenoid about one-third of a second. If, however, a construction is used in which all the groups of solenoids are not at once excited less than half the current will be used for the same effect, and the generation of heat in the outermost solenoids will be reduced."

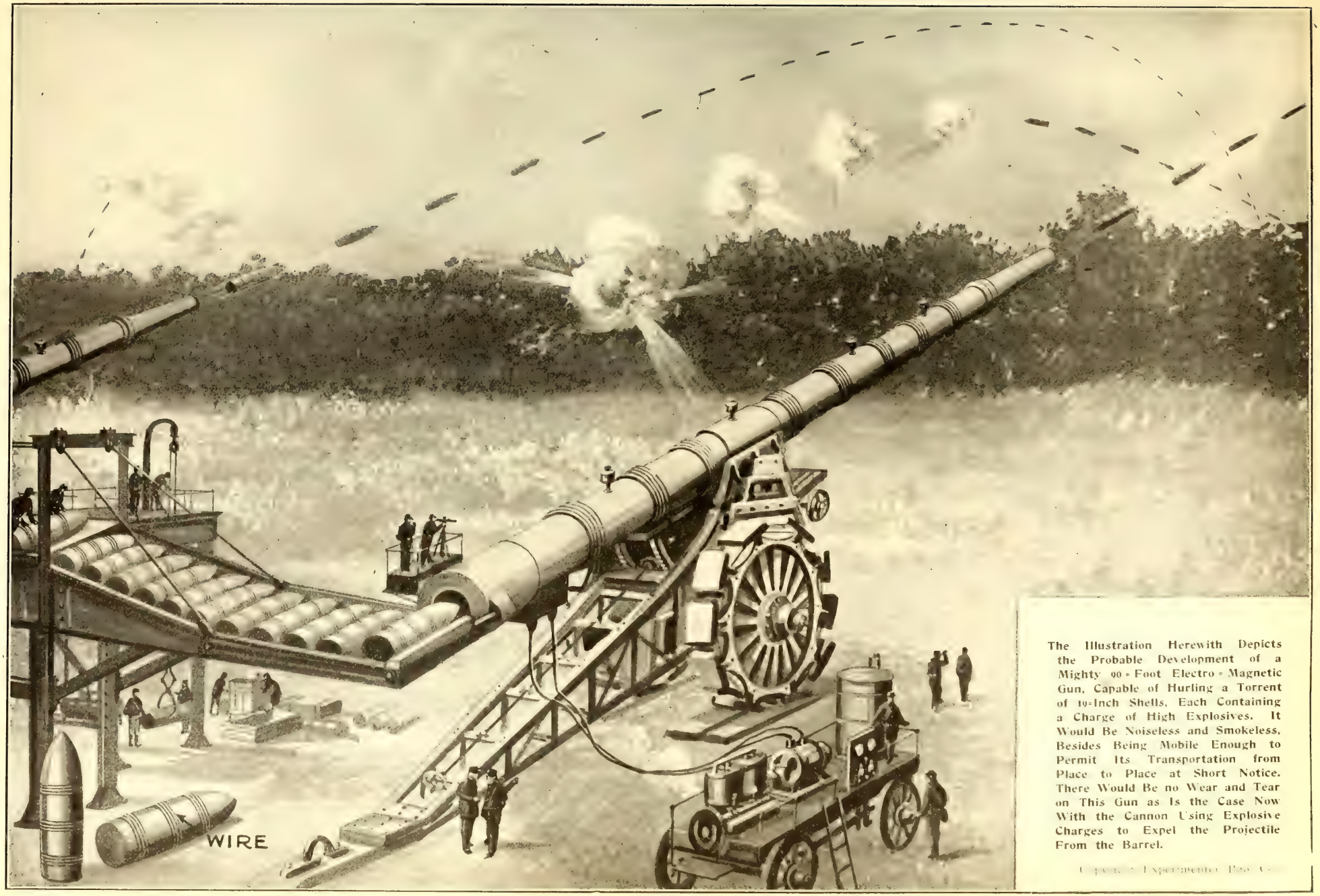
ENGINEERS FORMING RESERVE CORPS.

The movement begun in a tentative way last spring to form a reserve corps of engineers to be available in case of war has assumed definite form, according to announcements made by Bion J. Arnold, of Chicago, chairman of the A. I. E. E. committee of the proposed reserve corps of engineers.

Some time ago the suggestion was taken up by the American Society of Civil Engineers, the American Institute of Mining Engineers, the American Society of Mechanical Engineers, the American Institute of Electrical Engineers and the American Institute of Consulting Engineers. Each of these organizations appointed committees to further the movement, which has now become more closely consolidated by the appointment, just announced, of the chairman of various committees as members of a joint committee to take charge of the work in co-operation with the War Department. The members of the committee are as follows: William Barclay Parsons, New York, chairman, and Henry S. Drinker, Pennsylvania; William H. Wiley, New York; B. J. Arnold, Illinois, and Ralph D. Mershon, New York.

INCREASING WIRELESS RANGE BY KITES.

The recent manoeuvres in northeastern Massachusetts were of particular interest because of successful experiments by the Signal Corps in maintaining a wireless aerial at a great altitude by means of kites, and thereby increasing the efficiency of an ordinary field radio set from six to sixteen times. At the invitation of Adjutant-General Cole of the Massachusetts Volunteer Militia, Samuel F. Perkins, a maker and flyer of man-lifting kites, went to Newbury and experimented with the Signal Corps. As there happened to be fairly strong winds at the time, Mr. Perkins was able to send up a string of kites to a height of 1,600 feet. The messages transmitted from the kite-supported aerial are said to have been received 150 miles away with distinctness, although the field wireless set used would only transmit messages 25 miles ordinarily. The results were obtained because the kites flew so steadily that the aerial was always maintained at a constant altitude. The receiving qualities of the kite-supported aerial were remarkable. Messages were received from the battleship Georgia, off Newport, and from the Government stations at Arlington, Va., and Bermuda. Code messages being exchanged between two British warships out in the Atlantic Ocean were received with accuracy. Further experiments by the United States Government and Marconi officials are now being conducted, and it is expected that in a short time the range of sending from an ordinary field wireless set will be increased.



The Illustration Herewith Depicts the Probable Development of a Mighty 90-Foot Electro-Magnetic Gun, Capable of Hurling a Torrent of 19-Inch Shells, Each Containing a Charge of High Explosives. It Would Be Noiseless and Smokeless, Besides Being Mobile Enough to Permit Its Transportation from Place to Place at Short Notice. There Would Be no Wear and Tear on This Gun as Is the Case Now With the Cannon Using Explosive Charges to Expel the Projectile From the Barrel.

Fig. 2. Electro-Magnetic Gun of the Future, Which Can Hurl 19-Inch High Explosive Shells 25 Miles and More. It Could Fire a Perfect String of Shells, Sufficient to Batter Down the Strongest Forts.

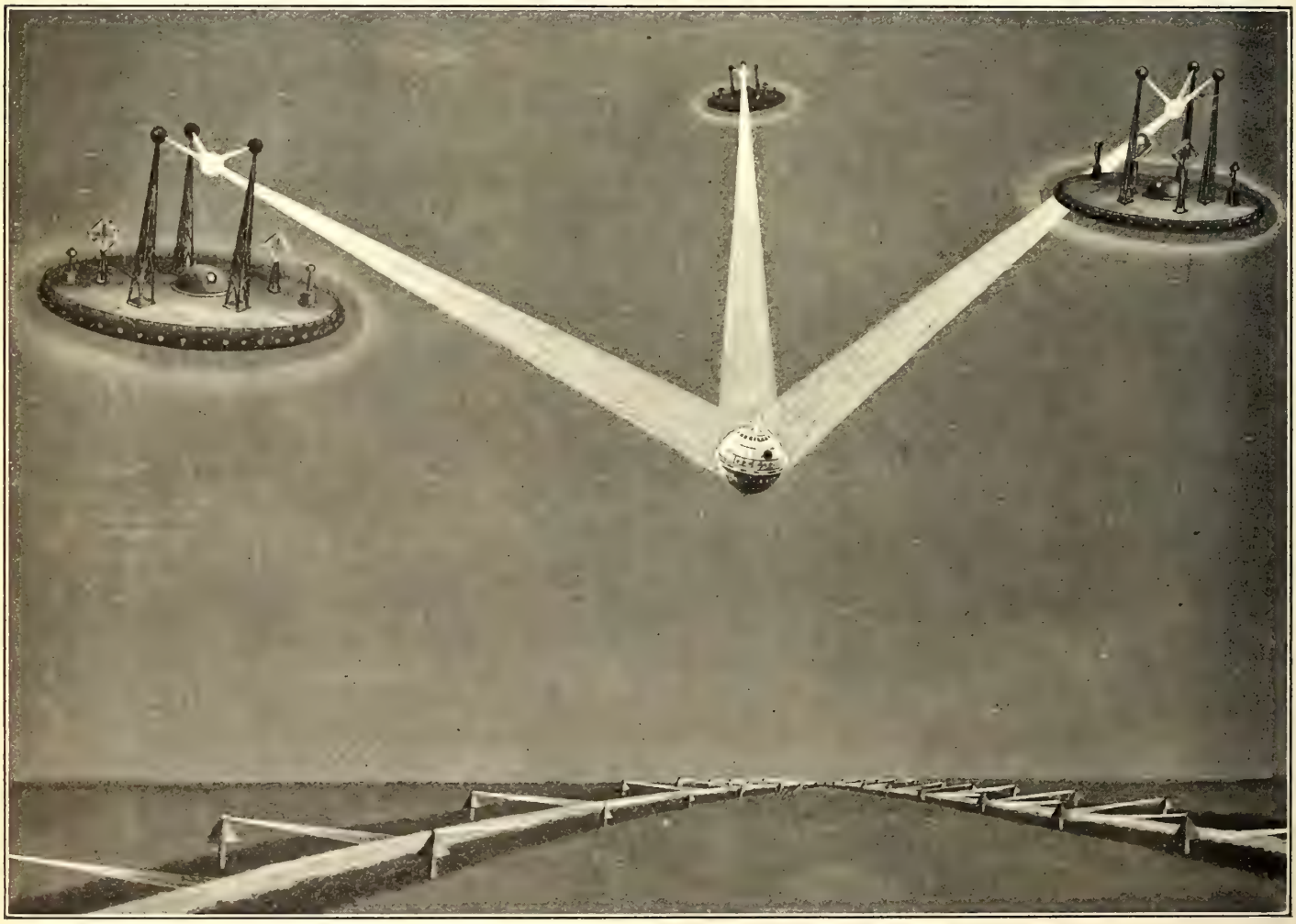
Baron Münchhausen's New Scientific Adventures

By Hugo Gernsback

Münchhausen Lands On Mars

FOR forty-one days I had been "listening in" nightly at my wireless set, since that eventful evening when Baron Münchhausen had left the Moon for the Planet Mars. He had said, of course, that it would take from 35 to 40 days before the "Interstellar" could negotiate the trip from the Moon to Mars, but nevertheless I became more and more impatient as the days wore on.

At last on the evening of the 42d day, at 11 o'clock on the second, the peculiar, unmistakable high whining spark suddenly broke in my ears. After the long nervous strain, the loud whistling spark, almost took me off my feet and I could hardly hear the first words, I was so excited. In a few seconds the whistling spark died down, and Münchhausen's dear, sepulchral voice sounded once more in my faithful receivers. And how loud it was! It was positively uncanny to think that I was listening to his "canned" voice, which perhaps 10 or 12 hours before had been hurled through the ether some 55 million miles away from the Moon, there to be registered phonographically on a telegraphone.



"Three Shafts of an Intense Yellow Ray Were Turned on us, and It Was the Peculiar Properties of This Ray Which Had Made us Captives to the Martians' Superior Intelligence. . . . ."

And now the Baron's voice through the wireless telephone sending plant on the Moon, 238,000 miles away from me, was talking! The thought made me shiver.

"Hallo, Alier," it came in a sympathetic voice, "how is old mother Earth and yourself? Too bad there is no return 'circuit,' for I would love to hear your dear voice. It's over 44 days since I have last heard it. Yet it can't be helped. Well, you must be satisfied to listen to me, without being able to talk back; but I'll try to be as explicit as possible, so that you will not be in a position to ask questions.

"Well, my boy, the trip from the Moon to Mars was entirely uneventful. As soon as we had our bearings we made straight for the Red Planet, the Mysterious. Flitternix and I took watches alternately and as we had learned from our former experience how to handle the 'Interstellar, the trip became more or less monotonous. We had a little trouble at the start with the switching of the Marconium netting, for it proved rather a puzzle to gravity-insulate the 'Interstellar' from the combined attractions of the Sun, the Earth and the Moon, and at the same time having the Planet Mars alone 'pull' us. This bothered us considerably for several days and we made but little headway during that period. Finally when the Moon, Earth and Sun, in the order named, were in a straight line, with Mars almost overhead, our speed rapidly increased and on the evening of the fourth day the 'Interstellar' was entirely gravity-insulated from the Moon, Earth and Sun. We were then 'falling' towards Mars at the rate of 20,000 miles an hour. Within 10 days our speed had increased to over 50,000 miles an hour, and the Earth which from the Moon appeared 14 times as large, as the Moon appears to you, had shrunk and shrunk till it looked like a small bright red disc. Mars in the meanwhile became rapidly larger and redder and soon it appeared like an ochre disc. At the end of the 35th day, when our speed had increased to 78,000 miles an hour, due to the proximity of the planet, the Earth had become a bright star in the firmament, somewhat brighter than the other stars, but a pitiful sight compared to what it had looked when seen from the Moon. But remember that the Moon is but 238,000 miles distant from the Earth, while we were now over 50 million miles away from it. Quite a little difference!

"The next day, the 36th since our start, we were but 200,000 miles distant from Mars, and the planet at this distance was indeed the most gorgeous sight either Flitternix or myself had ever witnessed. Mars looked now almost as big to us as the Earth does when viewed from the Moon. If the Earth when so viewed is a wonderful spectacle, the planet Mars when seen at such a small distance is simply over-

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IS Mars really inhabited by intelligent beings? Are conditions on this Planet such that life can be sustained on it? Some of the foremost thinkers in astronomical matters answer these questions in the affirmative.

The Spectral Analysis has revealed to us of what gases and matter the Sun is composed. By means of those piercing instruments *Logic* and *Deduction,* we are enabled to tell what is going on on Mars. This story advances some new ideas on the subject and we have a hunch that you will enjoy this installment.

whelming in its splendor. We saw a full red disc, dazzlingly illuminated by the distant Sun's rays. Like the Earth, Mars has a pink fringe running around the edge —its atmosphere. The continents stand forth in an ochre red, intermingled with dark green patches. Faint lines run over the entire face of the planet, like cobwebs —the famous Martian canals. At the top a brilliant white cap is observed—the north polar ice fields.

"But the most wonderful sight to us was Mars' two little moons. Flitternix calls them toy moons! Of these we had the best view the next day, when we were but some 10,000 miles distant from Mars.

*†"The Planet Mars has two tiny moons, christened Phobos and Deimos by terrestrial astronomers. They were discovered in 1877 by Professor Asaph Hall, of the Washington Observatory, and they are so minute in size that only the most powerful telescopes on Earth reveal them. The largest, Phobos, is some 36 miles in diameter, while the smaller, Deimos, is but 10 miles in diametr. The latter is such a ridiculously small world that a pedestrian would walk around its equator in a single day! An automobile, given a fair road, could circle this entire world in one hour, without exceeding its speed limit!

"Phobos, the largest moon, is less than 4,000 miles from the surface of Mars and revolves around the latter in the remarkably short time of 7 hours and 39 minutes. Consequently the Martians witness the spectacle of their largest moon going through all its phases in 7½ hours! In a single Martian morning, therefore, Phobos can be seen to rapidly change from new moon to first quarter, then full moon, then last quarter and finally again new moon; and all this in 7½ hours! A unique feature about Phobos, too, is that it revolves quicker around Mars than the latter revolves upon its own axis. Mars turns around its axis in 24 hours, 37 minutes and 22 seconds. Thus the Martian 'day' is almost 38 minutes longer than the terrestrial day. During one Martian day, Phobos therefore has spun more than three times around Mars! As seen from Mars, Phobos appears about as large as the Moon appears to inhabitants of the Earth. Deimos, the smaller moon, is 12,300 miles distant from Mars. Whereas its larger brother takes but 7½ hours to revolve around Mars, Deimos requires 132 hours to complete its circuit, or almost six days. Deimos, however, is so far removed from Mars and it is such a tiny object that to the Martians it really does not appear as a moon at all, as we understand that term. For it must be apparent that if we view an object measuring 10 miles across from a distance of 12,300 miles, we can hardly expect to see much. For that reason Deimos, when 'full,' appears only about slightly larger than the planet Venus appears to you as seen from the Earth. Therefore the Martian nights are not brilliantly illuminated by two large moons, as some writers would have you believe. To the contrary, the Martian night is very much like the terrestrial night, except that Phobos when full appears to shed more light on Mars than the Moon sheds on Earth. For the Martian atmosphere is considerably thinner than the terrestrial one, and for that reason it does not absorb so much light.†

"After circling around Mars at a height of 10,000 miles for some time, we finally decided to make a landing. By careful maneuvering and switching of our anti-gravitational Marconium netting, we finally descended to a height of but five miles from the surface of Mars. On account of the etherless zone of the Marconium netting when switched on, we could, of course, not see what was beneath us at all times, for light does not pass through an etherless zone. We therefore had only momentary glimpses of the planet during the short seconds when the current in the netting was switched off. This constant switching on and off of the current reduced our speed to almost nothing, and we were thus slowly approaching an open plain which we had picked out and which appeared like part of a desert, and probably sandy enough to effect a soft landing of the 'Interstellar.' From our momentary glimpses we had become more than convinced that the planet must indeed be inhabitated by intelligent creatures. We had snatched a good view of a wonderfully built city; had seen sections of the mysterious long waterways and their attending strips of vegetation, otherwise known as the Martian canals, and had also observed ponderous air craft by the thousand and curious structures near the canals that looked like gigantic pyramids.

"Had we still doubted that Mars was inhabitated we were taught differently in a few minutes, for things began to happen rapidly.

"When we were still about two miles from the Planet's surface, suddenly as if by magic, everything before our eyes became yellow. At the same time a peculiar numb sensation came over our bodies and we were hardly able to move hand or foot. Simultaneously the machinery of the 'Interstellar' became unmanageable, and looking through the lower portholes we could see that we were rapidly coming closer to the planet's surface, at the same time moving in a totally different direction from the one we originally were heading to.

"With some difficulty we managed to look up towards the top port windows and we saw a marvelous sight. Three circular massive, what looked to us like metal aircraft, spaced equal distances apart, were floating in space. The three flyers formed an equilateral triangle while in the exact center, but about one mile lower down than the flyers, our 'Interstellar' was floating. Three shafts of an intense yellow ray were turned on us and it was this light, or rather the peculiar properties of the rays which had made us captives to the Martians' superior intelligence.

"We reasoned that these floating forts must be used for defensive purposes on Mars, and we agreed among us that the best thing we could possibly do was to submit ourselves entirely to the Martians' will. Indeed, we were so helpless that we could not have offered any resistance, even had we wanted to do so. We, therefore, calmly awaited developments, for we reasoned instinctively that we would not be harmed. Nor were we mistaken in this view.

"The yellow rays guided the 'Interstellar' over a vast distance and at the end of an hour we were gently deposited on a huge grassplot in a fairyland 'City.' The instant that our flyer's broad landing belt touched the ground the yellow rays disappeared and immediately our normal facilities were restored once more. We were free to move and to act.

"We lost no time in unbolting our steel door, and in our anxiety to get out in the open, all three of us, Flitternix, myself and Buster, our fox terrier, almost tumbled over each other. I admit that on a historical occasion like this the first time a human being sat foot on another planet, we should have appeared more dignified as, for instance, Christopher Columbus did when he first landed on San Salvador. Sad to relate, however, there was nothing dignified nor solemn to the occasion of our landing, and this was partly due to Buster. That infernal dog insisted on running between our feet and succeeded in tripping Flitternix just as he placed his foot on the ground; if it had not been for me he would have sprawled all over the grass.

"It is a good thing that the Martians have a keen sense of humor, for the crowd that had collected around our flyer began to laugh uproariously in a queer, characteristic Martian falsetto voice. I admit that we offered a sufficient cause for amusement, the professor in his old Prince Albert and myself attired in my costume of 1797. However, we quickly managed to pull ourselves together and we blinked around us in unconcealed amazement.

"Although the Martian air is very much thinner than the Earth's atmosphere, we experienced but little trouble in breathing for our stay in the rarified air of the Moon had taught us how to breathe in thin air. We noticed immediately that the air was very pure and we did not cough once, as was the case of our landing on the Moon. The Martian air seemed rich with ozone, and we could not rid ourselves of the idea at first that we were breathing the strong air of a pine forest.

"But what held us spellbound for some minutes was the Martians themselves. I am not sure whether they were not as much astonished as we were; for as we found out later, the Martian can conceal his emotions far better than the proverbial Indian. While I was still staring at the nearest Martian with my mouth wide open, Flitternix, who had recovered first from his surprise, nudged me and said: 'Didn't I tell you?'

"Only then did I remember our discourse of the previous day, when we were speculating together as to the probable appearance of the inhabitants of Mars. I remember now that Flitternix had said something like this:

"We have seen on Earth that animal life is possible under the most adverse conditions. We find life at the North Pole in the most awful cold, and we find life at

* In order to disinguish facts from fiction in this instalment, all statements containing actual scientific facts will be enclosed between two † marks.—AUTHOR.

the equator in the most intense heat. We find life in the thinnest mountain air, and we find life at the bottom of the ocean. Particularly the latter is interesting for even up to a few years ago scientists of note denied that a fairly large creature such as a fish could withstand the enormous pressure of water at the bottom of an ocean. For the scientists argued that the fish would be crushed to death by the thousands of tons of water above it. Not only that, but it was furthermore argued that as it gets colder as one descends into the depths of the ocean the temperature finally drops below the freezing point of fresh water. How then could a fish live in such an abode? It was simply impossible. The fish might just as well live in a frying pan. The arguments were strong indeed against the possibility of life at the bottom of the sea.

†"'But then a man by name of Challenger came along and invented a deep sea dredge. No sooner had his expedition begun to dredge than they fished from the bottom of the ocean the most astounding specimen of deep sea fish built on a plan to withstand enormous pressures. True, they were dead when they arrived at the surface of the ocean, but this was expected, for as soon as the enormous pressure to which the fish was accustomed was taken away, he naturally burst inside. So our "wise" scientists with their beautiful logic were wrong once more and the impossible, as always, was very much possible.†

"'I mention this only in passing, to show you that life can accustom itself to *almost any condition.* There are indeed but few exceptions to this rule to my mind. Now, then, we have absolutely no right to believe that the little planet Earth, among the billions of worlds, should be the only fortunate one on which life thrives. †Arrhennius has demonstrated already how life is propagated from one planet to another. This famous philosopher has shown, that minute life carrying spores so small that they cannot be seen by the naked eye are carried through space, propelled by the pressure of the sun light till they strike another heavenly body. If the conditions are suitable the spore will germinate in time and life will spring up—if it is not there already—on that world. It has been proved that these spores can exist in an absolute zero and in a perfect vacuum for years, without losing their germination power—another proof how nature protects life under almost unbelievable conditions.† Therefore to say that there is life only on the Earth is not only idiotic in the extreme, but it also reveals a total lack of appreciation of the wisdom of Almighty Nature.

"'Now, then, it is an undisputable fact that plants, animals as well as humans, are entirely dependent upon their surroundings. If, for instance, you take an Eskimo and transplant him and his family on an island under the equator, his white color will change into black in a few generations. Likewise evolution shows that the human body very quickly adapts itself to the tasks imposed upon it. Thus a man whose grandfather and father were hard-working laborers, will nine times out of ten inherit a bony as well as robust body and a relatively small brain. Whereas a man whose grandfather and father were mathematicians nine times out of ten will have a comparatively small boned body, which is far from robust, but his brain will be large.

"'Surroundings are everything and given time they will transform man or animal into different beings than they were originally.

"'Now let us apply this reasoning to Mars and let us see what we will find. †To begin, it has been proved beyond dispute that Mars has an atmosphere, which although thinner than that of the Earth, is probably thick enough to sustain human life even as we know it. Professor Lowell has proved that the mean temperature on Mars is about 47 degs. Fahrenheit. In some sections as, for instance, near the equator, the temperature can surely not be less than 65 degs. F. It was argued in former years that, on account of the far greater distance Mars is removed from the Sun than the Earth, the temperature must be far below zero. Recent astronomical researches, however, completely disproved this. As a matter of fact, Mars proper receives really more heat than does the Earth for the following reasons: The Martian atmosphere is much thinner than the terrestrial, consequently the Sun's rays pierce it with far less loss than is the case on Earth. Then, too, there are no clouds on Mars to cut off almost 50 per cent. of the received Sun's rays, as is the actual case on Earth.

"'Then again the Martian day is almost exactly as long as the terrestrial. Also due to the inclination of the Martian axis, which is almost exactly the same as the one of the Earth, the seasons are exactly like the terrestrial ones except that they are twice as long, because the Martian year is just twice as long as the terrestrial one.†

"'Now, then, we know that the planet Mars, due to its small size, is a vastly older world than the Earth. Civilization on Mars must date back several hundred thousand years. The law of evolution teaches us that we must therefore expect a very cultured as well as accomplished race.

"'As our terrestrial evolution shows, the human head is growing larger and larger all the time. It must have been the same on Mars, for conditions here are almost the same as those on Earth. We must, therefore, expect to find a race with enormous heads. As the air is thinner on Mars sound will not carry as well as in a thicker atmosphere. We, therefore, will expect big funnel-like ears on the Martians to enable them to hear well. But a big head almost invariably has big eyes; from this we may safely deduct that the Martians have large eyes. But there is one important difference of physicial conditions on Mars, as compared with those on Earth, and that is gravitation. For what weighs one pound on Earth weighs but 0.38 pound, or a little over one-third pound, on Mars. Less bodily weight makes for excessive growth for the reason that gravity pulls less on the body frame. A little calculation based upon the above gravitational figures leads us to suspect that the average Martian should be about eight feet tall. As the sunlight is very much stronger on account of the thin air on Mars, the Martian unless he is in the shade most of the time has probably a dark skin, which may be as red as that of a North American Indian or as dark as that of a West Indian.

"'As the air is so thin on Mars and as oxygen is needed in large quantities for such big bodies as the Martians', we will not be surprised to find that the Martian has an immense torso, to accommodate his ponderous lungs. The latter must be doubly large in order to sustain such a large body and also to work over quickly the small percentage of oxygen in the thin air. But large lungs also invariably require a large nose, as we know from experience, on earth. Consequently, if the Martians have a ponderous nose, don't be surprised, for evolution shows us that animals breathe through their noses as a rule.

"'As to the Martian's hands, it is probable we will find them rather small in proportion to the rest of the body. The Martians have probably advanced so far that manual labor has been abolished for hundreds of generations. It is almost certain that as everything must be done with machinery, manual labor is absolutely unknown to-day on Mars. This naturally, in the course of several thousand years, begins to tell and the hands must shrink. We will therefore expect that the eight-foot Martian has a hand rather smaller than ours. Again, as no physical labor of any sort is performed by the Martian, his arms are probably thin and muscleless.

"'As to his feet, we shall find them to be very large in all probability. They must support a tall and rather heavy body, and they, therefore, must provide sufficient leverage to enable the Martian to walk properly. Not alone for the latter reason must the feet be large, but also on account of Mars' small gravitational attraction; for if the Martian's feet were small, he could not secure the proper foothold to propel his body, he would be hopping instead of walking.

"'Therefore when we behold the first Martian we will probably find him to look totally different from a human being, and while my reasoning as to his probable appearance may be inaccurate in spots, I am sure that on the whole I will be correct.'

"So spoke Flitternix.

"He was right, marvelously right. His

(*Continued on page* 371.)

SYNOPSIS

I. M. Alier, an eccentric young scientist of Yankton, Mass., who claims as his own many new as well as startling inventions, far ahead of anything as yet discovered, owns the largest radio-telephone plant in the country. One evening he hears strange noises over his phones and immediately a sepulchral voice is heard. It is Münchhausen, one of the greatest yarn and story tellers of all times. Münchhausen explains how it came about that he did not die in 1797, as popularly thought, and he furthermore gives unrefutable proof that his home is on the moon at present.

Alier wants to know why Münchhausen went to the Moon and how. The latter then explains how Prussia persecuted him and how he went over to the Allies and succeeded in capturing Berlin in a wonderful manner. However, it was not a complete success, so the Baron left Europe for America. He immediately constructs a machine which is to take him into space to the moon. Münchhausen has discovered how to neutralize Gravity by means of Electricity, and he applies this invention to his space flyer, the *"Interstellar."* The machine proves a success; it responds and is lifted with tremendous speed towards the moon.

Queer things are discovered on the way to the Moon, among others that bodies lose all their weight inside of the *"Interstellar."* Finally a landing is effected on the Moon in a desert, but great hardship is encountered on account of the Moon's rarified atmosphere. The party then leaves for the nearest mountain range, where they discover a huge subterranean cave and a lake filled with luminous fish. Bread trees are also discovered. Münchhausen next gives a vivid description of the Earth, Sun and the firmament as viewed from the Moon; he also explains how the continents and oceans of the Earth appear from the Moon. He then tells of the ponderous meteors which continually crash down on the Moon. Finally one falls down near him and the resulting concussion hurls Münchhausen in a bottomless crater, which goes straight through the Moon. He falls clear through to the other side, but his momentum brings him back to the starting point, where he is saved by his companion. They then decide to depart for the Planet Mars, but they leave behind them an automatic Wireless Plant, the "Radiotomatic," which will relay the messages from Mars to the Moon and thence to Alier. A popular lecture on Mars is also given by Münchhausen.

THIS STORY STARTED IN THE MAY ISSUE. BACK NUMBERS WILL BE SUPPLIED AT 10c. EACH POSTPAID.

Warfare of the Future

The Radium Destroyer

THE European War has clearly demonstrated what a tremendous part modern science plays in the offense as well as in the defense of the contending armies. It has often been said during the past twelve months that this is not a war so much of men as of machines. Nothing could be truer. In fact, it might be said that this is a war of infernal machines against more diabolical machines.

It has been stated editorially in this journal that there will be war always, or at least till we arrive at a period when some scientific genius (or shall be call him devil?) invents a machine which at one stroke is capable of annihilating one or several army corps. When that time arrives, soldiers, no matter how courageous, will think a long time before they will offer themselves to be slaughtered by the hundred thousand.

In the meantime, probably for many generations to come, the war death-dance will go on without any doubt whatsoever. Humanity simply has not advanced to such a state where disarmament is possible. Our real civilization only dates back less than 100 years, and as human progress is extremely slow, it may take a thousand years and more before humans will learn how to trust each other implicitly. As long as we require policemen and jails to keep us out of mischief, we are not able to take care of ourselves and we cannot call ourselves emancipated—we are still held in bondage by the brute in ourselves, which threatens to break out at any opportune moment, as is witnessed in the present war.

Therefore, the pacificists, particularly those in our country who think that this is the "last war" and who go around shouting peace at any price, are not only a sorry lot, but they are cheerfully oblivious of the teachings of history as well as of human evolution.

These good people would shout murder if you dared suggest to them to dismiss at once all policemen and patrolmen of their home town, but they would trust a strange nation implicitly from making war on this country, simply because that nation pledged itself on a piece of paper not to make war!

If the present war is ghastly with its poison shells, its deadly chlorine gas, its bomb-throwing aeroplanes, its fire-spraying guns, its murderous machine guns, etc., what can we expect of the wars of the future?

What will happen when the scientists of a hundred years hence begin making war on each other?

Suppose that by that time our scientists have solved the puzzle of the atom and have succeeded in liberating its prodigous forces. Imagine that at that time one atom can be disintegrated at will, instantly into another, what will happen? The results will simply be overwhelmingly astounding and almost incomprehensible to our present minds.

It has been calculated that if we could liberate the latent energy at present locked up in a *copper one cent piece* we would be enabled to propel a train with 50 freight cars over a distance of 600 miles!

Now, then, bearing this in mind, let us imagine that 100 years hence some scientist invents a means to unlock atomic forces, and how to control them. We can see him stepping to the throne of his future War Lord (if such still exist then), addressing him in this fashion: "My Lord, with the means of my invention the world is yours; will you make yourself the first Master of this Planet?"

The War Lord promptly asks for a secret demonstration of the new *"Atomic Gun,"* and what he sees intoxicates his imagination to such a degree that he decides to make war on the entire world as soon as his generals have assured him that enough atomic guns have been manufactured to make success certain. And one beautiful spring morning our War Lord finds a perfectly logical pretext to make war on a few nations, and the latest war dance is on.

Within a few hours the first atomic gun, popularly known as the *"Radium Destroyer,"* has crossed the enemy's frontier.

The Radium Destroyer is mounted on fast moving auto trucks and is controlled entirely by Radio energy. No man is within a mile of the Destroyer—it is too dangerous to be near it when in action. A young lieutenant with phones clapped over his head and who follows the Destroyer in the *"Control Auto,"* and who gets his own orders from the General Staff by Wireless, guides each and every motion of the distant Radium Destroyer simply by moving certain keys and switches in front of him.

Soon his Destroyer has arrived in front of the enemy's first line of concreted steel trenches, protecting the land behind them. In front of the trenches the ground has been purposely cut up to impede the progress of ordinary vehicles. The General Staff, of course, knew this, and built the Destroyer accordingly. Our friend the lieutenant stops the Destroyer's truck and moves a lever. Immediately the Destroyer hops from the truck and begins to jump with amazing speed over the cut-up ground, in grasshopper fashion. A few hundred feet from the well-concealed concrete trenches the Destroyer is made to halt. Our lieutenant moves a few switches, turns a knob and presses a key—then lo! the inferno begins.

A solid green *"Radium-K"* emanation ray bursts from the top of the Destroyer and hits the concreted steel trench. Our front cover gives but a faint idea of what happens. The Radium-K emanation has the property of setting off spontaneously the dormant energy of the Atom of any element it encounters except lead. So when the ray hits the trench it went up in dust, concrete, steel, men and guns behind it, everything. After spraying the trench lengthwise for a few minutes it is gone completely. Only a dense cloud of vapor hanging in the air remains.

The fleet of Radium Destroyers now enters through the gap, destroying everything in their path. No gun can hit the Radium Destroyer for ere the gun can get the proper range, the Radium-K Ray has hit the gun or the ground below it and has sent it up in vapor, including the men behind it. As a demonstration, the Commanding General asks that the first town encountered, a city of 300,000 souls, be vacated within three hours. The terrorized inhabitants are forced to comply with the request, whereupon a dozen Destroyers line up on the hills and spray the unlucky city with their fearful rays. Within five minutes the entire city, houses, churches, bridges, parks and everything else have gone up in a titanic Vapor cloud; only a vast crater in the ground where the thriving city one stood remains.

After this demonstration the enemy sues for peace; resistance would be folly. The country is conquered. Within a fortnight the War Lord has conquered the entire world and has proclaimed himself as the First Planet Emperor.

What happens afterwards when the secret of the Radium Destroyer is discovered by the War Lord's enemies is another chapter, so we will desist!

The above may read very fantastical and extremely fanciful. It is, however, not only very possible but highly probable.

Modern Science knows not the word Impossible.

ANENT WARLIKE INVENTIONS.

It is one of the anomalies of warfare that the machinery for fighting and killing has been brought to its present ghastly perfection not by swashbuckling, bloodthirsty soldiers, but by the mild-mannered, peace-loving civilians, says the *Review of Reviews*. True, both army and navy officers have exercised their ingenuity to heighten the terrors of battle, but theirs are rather academic improvements on the more daring contrivances of civilian mechanics and engineers.

Who gave us the turreted ironclad? Not a naval officer, but Ericson, a marine engineer. Who invented the machine gun, which squirts death every day on a dozen European battlegrounds? Not a colonel or a captain, but Hiram Maxim, a brilliant American mechanic. Who gave the battleship its quick-acting gun-elevating mechanism? Not an ensign or a commodore, but Janney, an American mechanical engineer. Who invented the motors for turning turrets rapidly? Not a lieutenant, but H. Ward Leonard, one of Edison's former assistants. Who planned the submarine? Not a Hull or a Nelson, but Robert Fulton, an artist.

So, one after another, the really important, the really epoch-making inventions comprising the mechanism of warfare prove to be the conceptions of romantically imaginative but lamb-like private citizens. Usually their contrivances are anything but perfect. They must be developed, and it is in their development that the professional soldier has been most serviceable.

It is thus not only with the guns and submarines of war, but also with the telephones and electric lights of peace; for the inventions that have made the United States and other countries commercially great came not from within given industries, but from without.

Always it is a dreamy pioneer, an intrepid free-lance, aflame with enthusiasm, who enriches his country with a radically new labor-saving device or way of utilizing energy. Morse was a portrait painter when he first turned his attention to the telegraph; Bell was a teacher of deaf mutes when he began his experiments with the telephone; Edison was a patentee of telegraphs and phonographs when he gave us the incandescent lamp; Marconi was a mere lad with a liking for physics when he conducted his first successful experiments in wireless telegraphy.

With the single conspicuous exception of Edison not one of the inventors who have blazed new trails gave to the world devices that could be marketed at once. Development was necessary—development by less brilliant intellects identified with the industries that were benefited.

WIRELESS ON CAPE COD.

The United States Navy will establish a wireless station on Cape Cod especially equipped to guide vessels along the Atlantic coast in time of fog.

When the Lights Went Out on the "Bella."

By A. Troubleshooter.

QUITE a few months ago, or, to be more exact, several years ago, the writer, who for the present must use the above nom de plume, had some unique experiences in overhauling the electric lighting equipment and generating plant on one of the numerous banana boats which ply between the port of Philadelphia and the West Indies. Probably a few reminiscences may be of interest in this direction, as the author had several quite out-of-the-ordinary problems to contend with in endeavoring to fix up the electric lighting equipment on this ship. She was built in England and answered to the name of "Bella."

It may be said to start with, and so that the reader will understand some of the problems encountered, that all of the wiring on this steamship consisted of a *toughly armored* copper wire, which had but a very thin rubber insulation placed between the "central" copper conductor carrying the current and its outer spiral *steel* wire armor. The dynamo room was located amidships in a compartment of the main engine room, and from this point, where the switchboard was also located, the various circuit wires and cables were led out through holes cut in the steel walls of the various compartments and decks to different locations about the ship. All of these lead wires and cables were armored, as aforementioned, and groups of them, containing often as many as 10 to 15 wires, were run along the steel hull of the boat or on the underside of the steel decks and subdecks, where they were firmly held in place by means of heavy brass clamps screwed fast to the steel plates.

The "beautiful" job of chasing out a ground on one of these circuits can be readily imagined, considering that such grounds were so common on many of our visits to the steamship while she was in port that often 15 to 20 grounds would be encountered and have to be cleared up in a couple of days before the "good" ship sailed on its return voyage for more bananas and "grounds."

Sometimes the whole group of these wires would have to be released from their numerous clamps for a distance of 100 or 150 feet before the grounded wire itself would be finally separated and distinguished from the others in the bunch. It was then, of course, replaced by new wire, and in some cases entirely new circuits were run in conduit or pipe.

This vessel carried a good size searchlight projector on the navigator's bridge above the pilot house and was supplied with electric current through two large size stranded copper cables, which were rubber covered and also finished with a heavy braided outer coating. These cables were *strapped* onto the steel walls of the boat and compartments, and one of the largest size "grounds" ever seen in captivity was presently discovered, and existing on one of these searchlight feeders.

The ground was tested at the switchboard in the dynamo room with a magneto and, of course, no great trouble was thought to be in store for the "trouble-shooters," as it was thought possibly the cables had by *electrolysis* become grounded at some point along their course. But, lo and behold! when this cable was traced from the switchboard it followed the wall of the engine room forward toward the front of the vessel and disappeared through a tightly fitting bushing in the steel wall of the engine room. At this moment it was thought that by simply going up to the deck and re-entering the "hold" through the coal bunkers that this cable would be in sight again of course. We supposed it simply passed through a ½-inch steel wall *only,* but instead it passed directly through a steel "bulk-head" about 10 feet thick, and the only way to get inside that "bulk-head" was to cut a hole through the steel shell of same. If it had been possible or convenient at the time I suppose we trouble-shooters would have been at liberty to use an oxy-acetylene flame to cut a hole through the "bulk-head." This problem was finally cleared up by running a cable up to the top of the engine room and along the deck, and so on up to the searchlight on the "bridge."



"Electrical Trouble-Shooting on the Good Ship 'Bella' Was Somewhat Exciting, to Say the Least."

Moreover, this job was not only that of a trouble-shooting expedition, but also about 50 per cent. of the time was occupied in killing multifarious and multitudinous myriads of a heterogeneous mob of "scorpions" and "centipedes," some of which were large enough to fill a soup plate. The greatest variety of poisonous "bugs" and other kindred *animals* of this character that were ever encountered in the writer's experience were met with on this memorial trouble-shooting raid. All sizes and colors of spiders, from those as large as a 5c. piece up to those ½ foot in diameter were frequently met with in our travels about the boat, especially at night, when we often explored the cavernous depths of her hold by the scintillating illumination of a smoky coal-oil torch, which manifested an exasperating habit of "extinguishing" itself automatically about four times a minute, more or less; usually more. Thus it behooved us to carry a large supply of matches in our pockets, as it was no small joke to be way down in one of the lower decks without a light or even a match at night, when about 5,000 rats used to hold pow-wows in the center of the floor.

One of the most exciting explorations conducted on this steamship was about the "steenth" visit we made to her and which became necessary in order to repair the *stern signal light,* which was secured to the rail about the deck. In order to get at the wire supplying this *stern* light it was necessary to crawl into the sail and paint storeroom in the stern of the boat, and which was packed full of canvas and other miscellaneous "junk" to within about 1½ feet of the ceiling, or, rather, the underside of the deck. The writer crawled in on top of these sails and whatnots in this instance for a distance of about 40 feet. This hair-raising and adventurous excursion, which was accomplished by wiggling along on the stomach, was also accompanied by much muscular exercise entailed by the necessity for manipulating one of those *famous,* forever smoking, coal-oil torches in one hand, while in the other a five pound ball-pean hammer served to snuff out the life of about 400 regular sized (4 to 6 inch) bandy-legged spiders, and also several dozen 12-inch centipedes thrown in for a good measure. This may sound somewhat "tame," but when it is realized that a bite from one of these centipedes or spiders (which thrive, of course, primarily in the West Indies, where the bananas grow) means death in 10 minutes or less, it will be seen that this was "some" job.

When the trouble-shooting "staff" first tackled this boat problem, with her numerous grounds and other complaints, they were, needless to say, *some tall land-lubbers,* and it very shortly became necessary for the rapid expedition of the work that they pick up the *language* of the ship, such as "for'd" and "af't," and it was very funny at times when some of the electricians would get so mixed up with the various locations of circuits about the ship that they did not know when asking one of the crew for information whether they were going in the right direction or not. The "staff" that endeavored to care for the "Bella's" diseases and complaints had a large variety of experiences before they got finished with the job, and some of these included being hoisted up the main mast in a boatswain's chair, which consisted of a piece of planking with a rope secured to same at either end and which was then fastened to a single rope passed through a tackle block at the top of the mast. One of the boys really got so used to this "bobbing up and down" on the main mast that he could always smell trouble a mile off, especially on a clear spring day, and emanating *particularly* and *only* from one of the "signal" lamps at the peak of the mainmast.

To cap the climax, and because the trouble-shooters had not finished up all of the circuit troubles on board on one of

(*Continued on page* 373.)

What the Housewife Should Know About Electricity.

By L. Shaw, Jr.

"I WANT to buy an electric fan," said the young woman with a sweet voice and smile that blended perfectly.

The salesman was equally affable. With a reciprocative smile retorted:

"Yes, madam, 'A. C.'or 'D. C.?'"

The radiant countenance changed as if by magic to one of perplexity, which was plainly evident by the intended purchaser nervously biting her lips.

The salesman's query resembled much the ever-mystifying technical phrases of the family physician.

The lady in question realized that she should have been versed in the matter of buying an electric fan, but being probably the first one she had purchased, accounted for ignorance on the subject. However, it calls to mind one clear and important fact: That since the use of electricity has entered into the household something in a primary way should be learned about it. Ignorance or indifference may cause much annoyance and often fatal results.

The average housewife has an insight as to the workings of her sewing machine and a general layman's knowledge about coal gas; then why not know a few simple imperative things concerning electricity?

Automatically the second question arises: "What should the housewife know about electricity?" The incident of the electric fan answers one query. The kind of current supplied to the house, whether it is "alternating current" ("A. C.") or "direct current" ("D. C.") should be known. The next essential thing to know is the "voltage."

Taking chances is poor policy where electricity is involved. This was only too well realized by the woman who bought a 110-volt fan and connected it to a 220-volt circuit. The fireworks which resulted afforded much amusement to the children and the maid who witnessed the display on a date that was nowhere near the fourth of July, but the husband who paid for the fan did not seem to think it such a funny incident.

Voltage and kind of current are imperative bits of information to one who would purchase any heating or electro-mechanical appliances, such as the former, an electric stove, percolator, sad iron, soldering iron, or the ordinary Mazda or carbon electric lamp. In heating devices the kind of current is not so essential as being versed as to voltage. The latter is important. In the second instance, while there are electric fans and vibrators which are "wound" to take either alternating or direct current, it is more common for such apparatus to be made to work on one or the other current. Knowledge of the voltage is absolutely essential in both instances cited.

As it is probable that the reader of this magazine is of the mere male sex, the writer humbly suggests that his audience make an earnest attempt to enlighten his mother, sister or wife (or intended spouse) with a few simple, common facts about the general uses and application of the electric current common to the household.

In order to show how much enlightenment is necessary another case of no less import than already cited is recalled to the mind of the writer.



The Lady From the Limousine Gave Me an Imperative Order to Send "12 Festoons Like Those," Without Even Thinking of Voltage, and Disappeared Forthwith.

About two Xmastides ago, during the rush so common at that time of the year, a lady whose limousine and livery which stood outside and general appearance bespoke of money and culture, stepped to the counter where I happened to be assisting during the holiday rush and in apparent hurry picked me out and demanded in a very pompous manner that she wanted some "Christmas tree" lights (festoons). Incidentally I had been demonstrating a large festoon to a prior customer, but they were of the battery type. I was unscrewing the bulbs with the intention of replacing them into the box and laying them near by for the next customer. Without the least opportunity to make intelligent inquiries as to the type of lights she wanted my lady, with the breezy ways, in a Napoleonic fashion pointed to the battery festoon to which I alluded, threw down an engraved visiting card, flew out of the store and before I had time to realize it the limousine had disappeared. I obeyed her commands, sending by special messenger 12 (eight-light) festoons. My only guide being the command and the daintily engraved card upon which was scribbled: "12 festoons" (whoever wrote it had found out at least that they were termed "festoon"), but had apparently forgotten to write the voltage and left it to the discretion of the salesman. Even the most intelligent discretion used is sometimes miscarried. In this instance it might have been that the lady wanted the battery type for her country home, where oil lamps were still in vogue. Or she might have desired to present them to a friend or relative not so fortunate as to have electricity in the house.

To make a long story short, the 12 battery festoons were returned the day after Christmas, every lamp of which was completely burned out, accompanied by a curt note, criticising quite openly the fact that the writer was not a mind reader and adding insult to injury by demanding a credit for the goods, also gently reminding that the Yuletide in a Fifth avenue mansion was completely and wantonly obliterated. On Fifth avenue, as might be known, 110 volt current is used. Merely as a matter of courtesy my firm adjusted her claim, although it can be clearly seen that the breezy limousine lady was too busy and indifferent to see that she gave an order correctly. It is even more important where a hasty delivery is desired, to make sure that an order of this kind is properly given.

The electric meter or the label on an ordinary electric lamp will quickly determine the kind of current and its voltage. A few brief intelligent questions at time of purchase and studying printed matter, which often accompanies such purchase, will often obviate considerable inconvenience and perhaps accidents—often fatal.

So get busy Mr. Man and tell the women folks something about electricity. It may save you money.

COMPARATIVE COST OF CANDLE AND ELECTRIC LIGHT.

Engineers of the New York Edison Co. have recently concluded a series of tests showing the comparative costs between candle light and electric light. In spite of the fact that candles may be purchased as cheaply as a cent each, this is the most expensive illuminant available.

One cent will furnish 2.68 candlepower-hours of candle light. For the same money and using the drawn-wire Mazda lamps 120 candlepower-hours may be obtained, while the recently perfected gas-filled lamp will give 192.3 candlepower-hours.

The figures are the result of tests with six candles of the ordinary commercial types. Four were tallow and two were sperm. They varied from 4.875 inches to 5.75 inches in length, and were from 0.75 to 1.125 inches thick. Three cost one cent each, two cost two cents each and one cost 3.5 cents.

One of the one-cent candles burned 2 hours and 22 minutes, another burned 2 hours and 24 minutes, while the one-cent sperm candle lasted 3 hours and 47 minutes. The two-cent tallow candles lasted 4 hours and 24 minutes and 5 hours and 31 minutes, respectively. The 3.5-cent sperm candle lasted almost 9 hours. The cost of electricity was computed at 8 cents per kw.-hour.

MARCONI PLANS CONTROL OF AIR.

Wonderful stories are being whispered of a new Marconi invention. It is declared the inventor of wireless telegraphy has found a way to utilize Hertzian waves in such manner that aeroplanes can be brought to a standstill and held immovable in the air. Experiments ,so the report goes, have been conducted with great secrecy until the invention has been perfected and soon will be in use. The mind picture presented of air machines held stationary in the air while guns of the enemy below were shooting them to pieces offers a new thrill of horror for followers of war news.

Something About Selenium

SELENIUM is one of the most puzzling elements known to the scientific world, due to its extraordinary property of varying its electrical resistance when exposed to light. This phenomenon has been known for many years, but the commercial application of this property possessed by selenium has not been properly appreciated up to the present time.

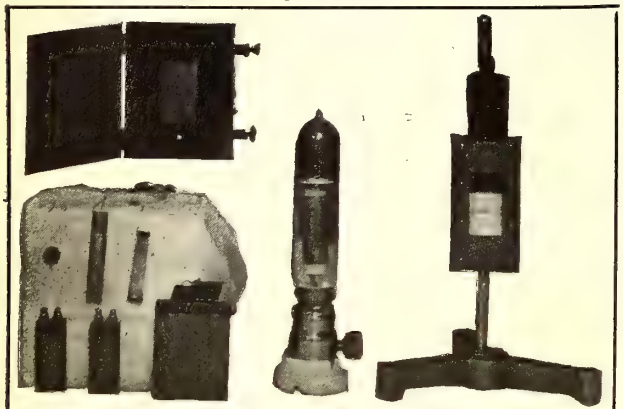


Fig. 1. Several Specimens of Successful Selenium Cells.

It is the purpose of the writer in preparing this article to make known the properties and enumerate some of the useful applications of selenium, which undoubtedly will be valuable to the readers who are interested in scientific research, as there is a promising field for the use of this marvelous element.

This peculiar substance, discovered in 1817 by Berzelius, an eminent Swedish scientist, is a by-product from the distillation of sulphuric acid from iron pyrites (a sulphite of iron). The proximity of the earth and moon suggested to Berzelius the name "Selenium," after the Greek "selene" (moon); this being the result also of the striking similarity of the properties of selenium with those of tellurium, which is a term derived from the Latin "tellus" (earth). It is a metallic element of the sulphur group and has neither taste nor smell. It melts at 212 degrees Centigrade, and if allowed to cool rapidly from its molten state it forms a brown amorphous mass, and in this condition it is a high-class insulator; it is said that a small stick represents a resistance equivalent to a wire stretching for about 250,000 miles. The reddish vapor produced by boiling selenium, which has a decided smell of radishes, is exceedingly poisonous, and care should be taken when experimenting with it when it is in this boiling state. In commercial form, selenium exists in sticks resembling a gray sealing wax, and if it is to be used for making selenium cells it must be chemically pure.

Selenium cells are usually made by winding two bare conducting wires side by side around a piece of mica, slate or porcelain and coating them with a thin layer of selenium. An excellent description of how such a cell is made is given in the August, 1914, issue of this journal. Such cells vary in resistance from 2,000 ohms or more in the dark. This depends mainly upon the thickness of the selenium coating and the amount of light acting upon it; *also upon the very important annealing of the cell.* In Fig. 1 is shown an illustration of a number of types of selenium cells, including the Bidwell, Ruhmer, Giltay, Webb, Clausen and Bronck, Mercadier and Fritts.

The two cells to the extreme right and left are modifications of Shelford Bidwell's cells; the one in the upper left-hand corner is the Ruhmer tube form of the Bidwell type. The one to the right is a Giltay cell. The four tiny ones shown against the white background were made by Mr. Webb, which are also forms of Bidwell's cell, while the center one is of the Fritts gold-foil flat type, which is extremely sensitive. William J. Hammer has patented an exhausted cylindrical cell made of quartz, so as to allow the ultra-violet rays which will not pass through the glass to readily affect the selenium, which is coated over the surface of a copper tube mounted on a central support; over the selenium is a thin tube of metal such as aluminum foil, thin enough to allow light to pass through. The copper and aluminum connect to the two electrodes.

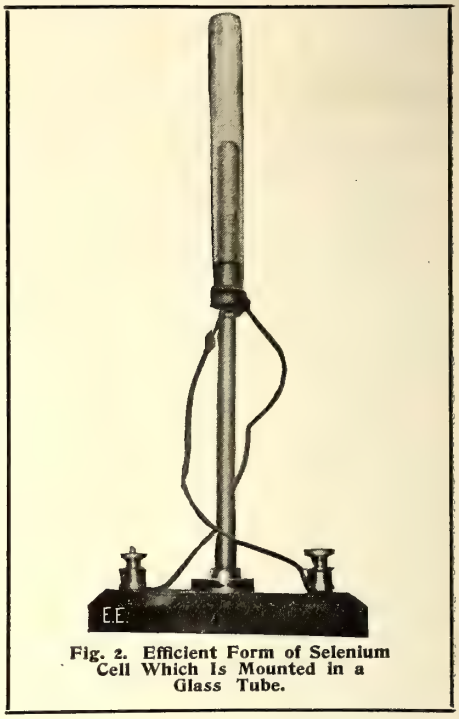


Fig. 2. Efficient Form of Selenium Cell Which Is Mounted in a Glass Tube.

A very sensitive selenium cell was made by Samuel Cohen, and is illustrated in Fig. 2. It consists of a number of circular metallic discs separated by mica, and the sides are coated with a thin coat of selenium. The complete unit is placed in an exhausted glass bulb

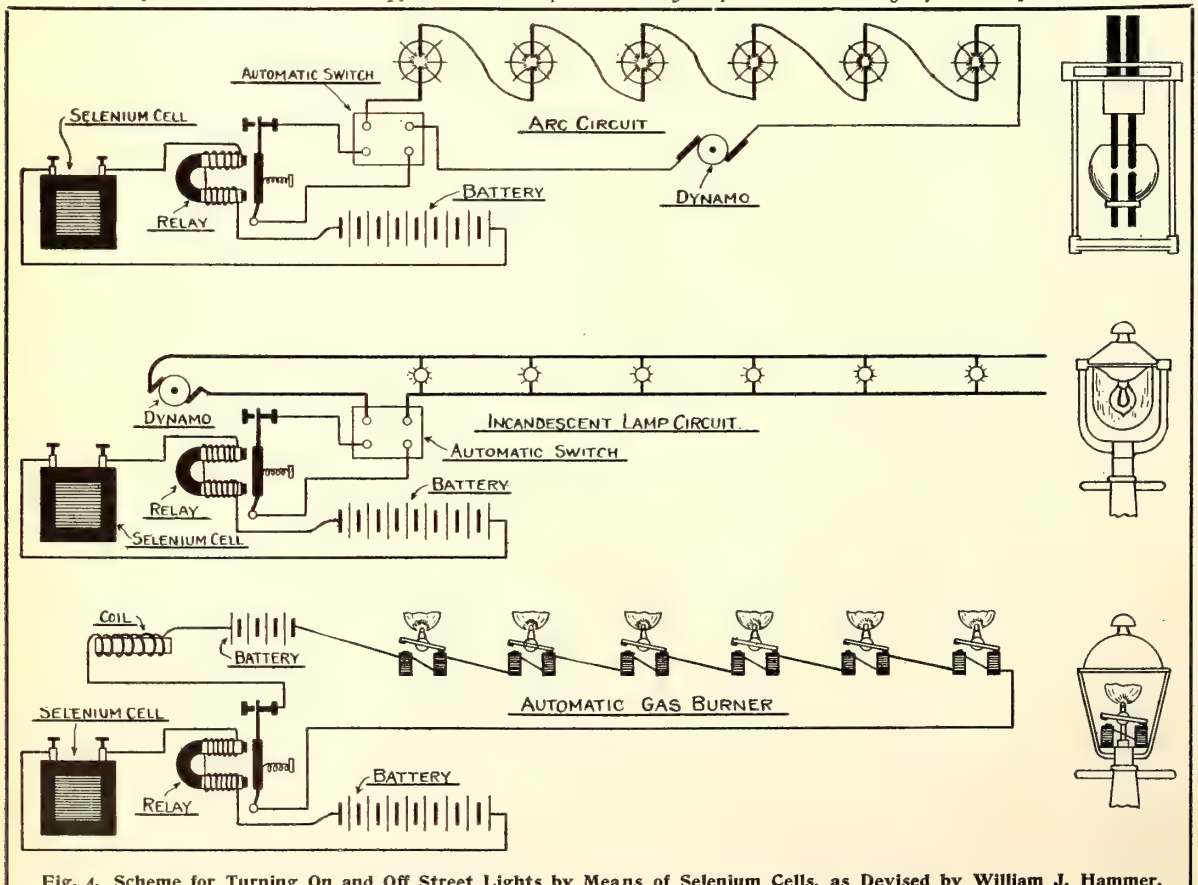


Fig. 4. Scheme for Turning On and Off Street Lights by Means of Selenium Cells, as Devised by William J. Hammer.

as shown. A small concave mirror is placed behind the cell for concentrating the light at the rear of the selenium surface.

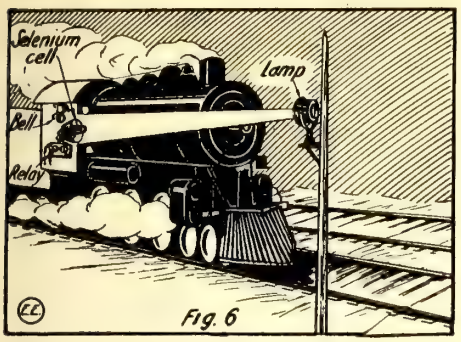


Fig. 6. Selenium Cell Applied to Safety Stop for Railroad Trains.

Having thus briefly glanced over the properties of this element and certain types of cells, we are now ready to consider some of the commercial applications of the selenium cell, some of which already have been worked out in actual practise.

Fig. 3 depicts the general connection of a selenium cell, battery relay and its secondary circuit. The selenium cell is connected in series with several cell batteries and a relay. As soon as the cell is placed in the dark its resistance is increased, consequently decreasing the current in the relay coils. The secondary circuit is therefore open, but as soon as some source of light is brought near the selenium the resistance drops, thereby allowing additional current to flow through the windings, which attracts the relay armature and in turn closes the secondary circuit. This is the fundamental circuit of most devices which are operated by selenium, and the principle holds the same as in this case.

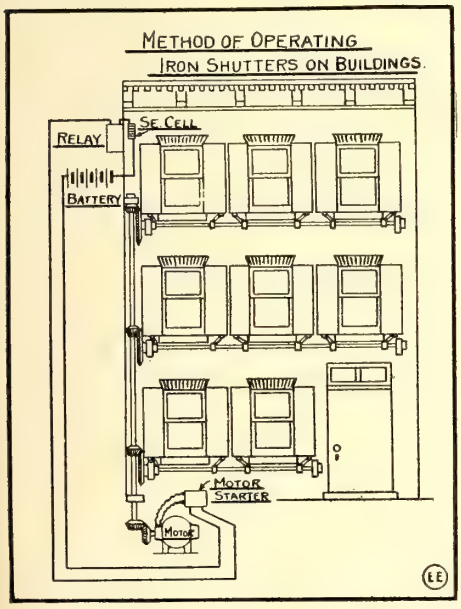


Fig. 5. Two Schemes for Opening and Closing Window Shutters at Sunrise and Sunset by a Selenium Cell.

A very interesting and practical application of this element is in the automatic lighting and extinguishing of street lamps. Fig. 4 shows a schematic arrangement which has been actually demonstrated by William J. Hammer. This scheme he submitted in 1886 to the convention of the Edison Association of Illuminating Companies at Rochester, N. Y., during a discussion upon "Metering Versus Contract Systems." Such a method of utilizing selenium cells to control relays and magnets, which would turn off the gas lights on the approach of day and turn them on again at night, would solve the problem of employing a squad of men necessary to do this work at present.

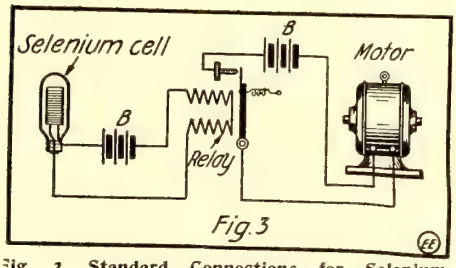


Fig. 3. Standard Connections for Selenium Cell and Relay.

Two other applications of selenium devised by the same inventor, similar to the device just described, are an automatic window shutter, illustrated in Fig. 5, that will close the shutters at night and reopen them in the morning automatically, and a very striking use of selenium in the protection of safes, storage rooms, etc., where the selenium cell is so placed in the room that whoever enters with some illuminant will be detected by means of the cell. Thus, if a burglar should enter the apartment the light from his lantern will be caught by the cell, which will actuate a bell signal, thus giving an alarm, enabling the police to surround the premises.

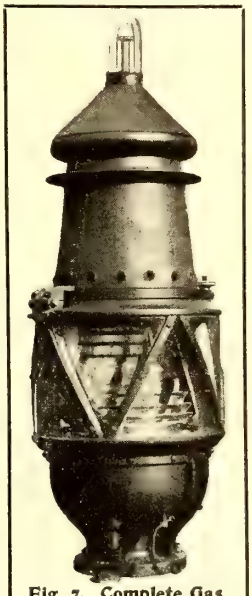


Fig. 7. Complete Gas Buoy With Selenium Cell Control.

Automatic signaling to engineers on railroad trains, etc., can readily be accomplished by the proper use of selenium cells, and Fig. 6 depicts such a device which consists of a searchlight placed some distance away from the signal block. The apparatus on the train constitutes a selenium cell, placed as perceived, with a relay properly connected in series with some source of current, and a bell or any other signaling device. Now let us suppose the train, traveling at a high speed, approaches the signaling block. The engineer's attention, for some reason, is drawn away from the block, which shows a distress signal. This negligence may perhaps result in a tragic accident. On the other hand, let us suppose that such a device as above described were installed on the train and a searchlight placed about 600 yards before the block. Now, when the train passes this lamp it will immediately cause the selenium cell to close the relay, thus ringing the bell, which would be an announcement to the engineer that the signal block was being approached. Of course this particular scheme would be used only nights. In this way some fatal accidents might be avoided. A more elaborate device was devised by Mr. Hammer, whereby a bell was rung, the whistle blown and the brakes set automatically when the semaphore and signal light showed that the line was blocked. His system is arranged to operate both night and day. A system of this nature is very practical and, if properly developed, will undoubtedly prove quite successful.

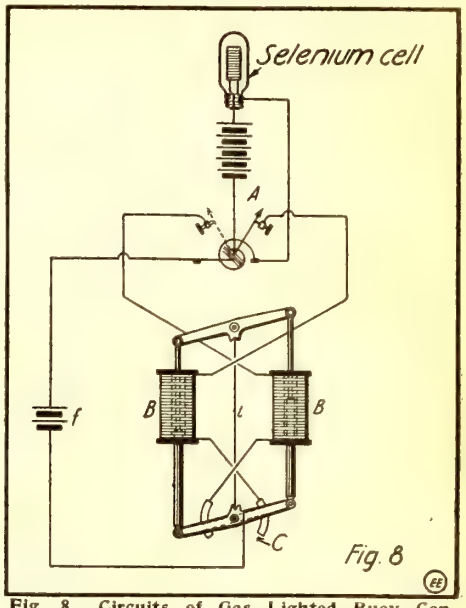


Fig. 8. Circuits of Gas Lighted Buoy Controlled by Sun's Rays Affecting Selenium Cell.

Still another practical application of the selenium cell has been made by the late Ernest Ruhmer, of Berlin, Germany, in connection with a Pintsch gas buoy. A large number of these have been built containing a supply of compressed gas which would last for one month. But it was necessary to burn these lights day and night, it being impracticable by reason of the distance at which they were placed and the frequency of the storms, etc., to turn off the gas so that it would not burn during the day.

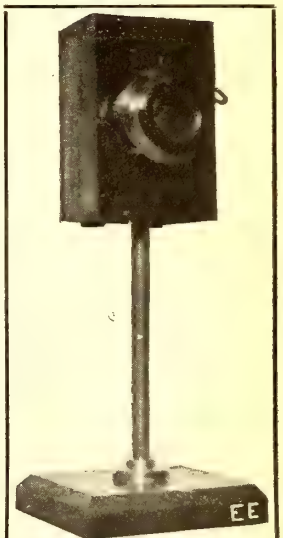


Fig. 10. Special Selenium Cell Device for Timing Photographic Shutters.

Mr. Ruhmer, however, placed one of his selenium cells in the top of such a buoy, connected with a switching device which, as soon as the sun rises in the morning, causes the selenium to reduce

its resistance, thus causing the mechanism to turn off the gas. It is again turned on, due to the increase of resistance of the cell, by the approach of nightfall, or also, if so desired, in the case of darkness due to a storm or fog. A buoy containing sufficient gas for one month could thus be made to do actual service without recharging from three to five months. Such a buoy is shown in Fig. 7. Mr. Ruhmer told Mr. Hammer that upward of 100 of these buoys had been made and had given excellent satisfaction.

The arrangement of the circuit, as originally devised by Mr. Ruhmer, is shown in Fig. 8. The voltmeter needle A has been replaced by the relay. B, B are two large "sucking" solenoids for operating the gas valve. A single dry battery is interpolated in the selenium cell circuit as usually employed. This battery will last for years and, with its relay, is placed in the bottom of the buoy and arranged to be absolutely waterproof.

Sir William Crookes has constructed an exceedingly interesting type of his well-known radiometer, in which he has coated the revolving vanes on one side with selenium and on the other with chromic acid. He found that the white light from a sperm candle repelled the selenium, while the yellow light of the wax candle repelled the chrome, thus indicating the relative absorptive powers of the different substances for rays of different refrangibility resulting in mechanical motion.

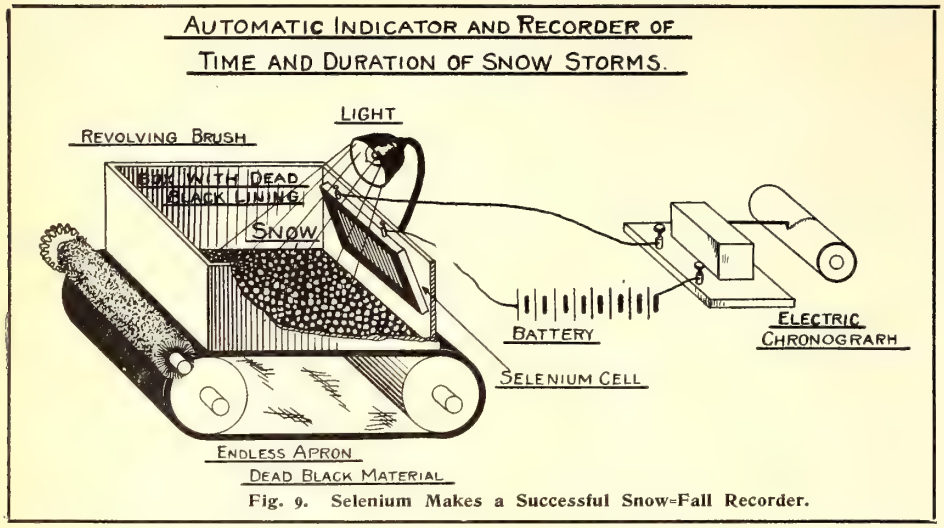


Fig. 9. Selenium Makes a Successful Snow-Fall Recorder.

Prof. Barnard, of Lick University, employed experimentally a selenium cell as a device for automatically detecting comets, and Minchin has employed the selenium cell quite extensively in his astronomical investigations.

A very ingenious device, using this wonderful element for recording electrically the amount of snowfall which occurs during a certain period of time, was devised by Mr. Hammer and is illustrated in Fig. 9. It consists of an endless black belt or conveyor, mounted on two reels and forming the bottom of a box as depicted. A selenium cell is placed above this belt and is connected with a suitable battery and an electric chronograph, or instrument for measuring time intervals. A small circular brush is placed near one end of the belt for removing the snow as the belt is slowly revolved by the pulleys. The complete apparatus is placed outdoors with the exception of the recording device, which in this case is the chronograph. The drums are now started. As long as it snows, the snow upon the slowly moving belt will reflect the light produced by the electric bulb upon the selenium cell and in turn indicate on the chronograph, and as soon as it stops snowing the black surface of the belt absorbs the light, thereby preventing the selenium cell from obtaining sufficient light; consequently it will not show upon the scale of the recording instrument. Such a device is very practical, as it will show exactly and accurately the time when it snowed and how often it snowed during the night, it being a simple matter to keep the record during the daytime. At present there is available for the Weather Bureau only an instrument which measures the depth of the fall of snow in a box protected from the wind to prevent drifting.

A very striking experiment has been performed with selenium by S. Cohen in recording the speed of photographic shutters. The apparatus is shown in Fig. 10, and virtually consists of two selenium cells, properly compensated with a Wheatstone bridge and galvanometer, whose needle is placed upon a chronograph cylinder having a proper scale divided in fractions of a second. The operation of this device is as follows:

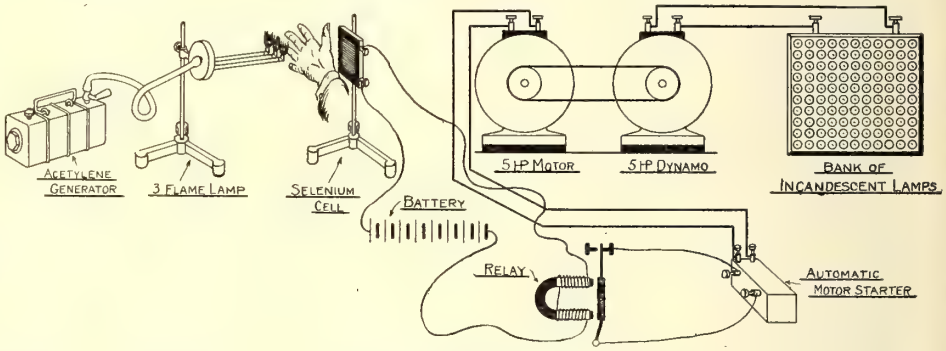


Fig. 11. Arrangement as Used by Wm. J. Hammer for Controlling a 5 Horsepower Motor by a Wave of the Hand.

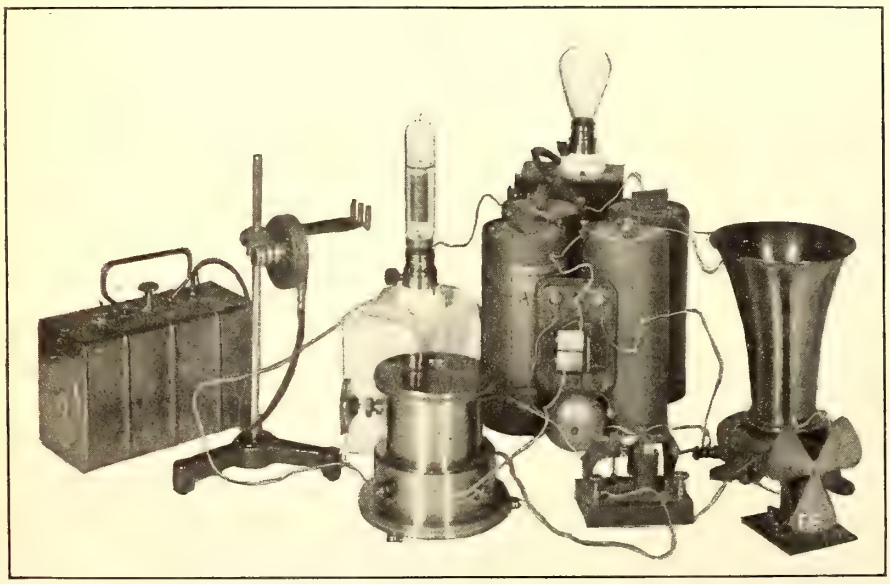


Fig. 12. Selenium Cell and Auxilliary Apparatus for Laboratory and Lecture Demonstrations.

The Wheatstone bridge is very finely adjusted and a light from an incandescent electric lamp is placed near the shutter; the chronograph is started and the shutter is released. The small amount of light which passes through the shutter acts now upon the selenium cell, thereby reducing its resistance and in turn unbalancing the complete circuit. Momentarily, in turn, it deflects the galvanometer pointer. This is recorded upon the scale of the chronograph. The time is then read by the length of the line made by the needle. This device has been worked out in practise and it is another achievement in electric speed indicating devices.

Still another wonderful experiment was performed with the selenium cell by Mr. Hammer at the joint meeting of the American Institute of Electrical Engineers and the American Electrochemical Society, April 17, 1903. The amazing feat accomplished by him was starting and stopping a five-horsepower electric motor by a mere wave of his hand in front of a selenium cell. The apparatus used in this experiment is shown in Fig. 11. It consists of an acetylene generator supplying gas to a burner placed before the cell, as shown. The cell is connected with a relay

(*Continued on page* 373.)

Wireless Telephony Now From Washington to Honolulu.

THE most wonderful feat in wireless telephony was accomplished on the night of Sept. 29 last, when the human voice was projected through the ether from Washington, D. C., to Honolulu, a distance of 4,900 miles!



Views From Left to Right: Dr. Lee de Forest in His Laboratory. Dr. de Forest Holding One of His New Regenerative Audion Bulbs of the Type Used in 4,900 Mile Radiophone Talk. Top Right: Shows Mr. Theo. N. Vail, Talking From New York to San Francisco by Wireless (via Arlington). Bottom Right: Progression From First de Forest Audion Detector at Right, to Latest Oscillation Tube Generator at Left.

Only a few hours earlier wireless telephonic communication had been established between New York City and San Francisco, a distance of 2,500 miles, which was heralded as an epochal innovation.

Secretary of the Navy Daniels has announced the successful transmission of wireless telephone messages from the United States naval radio station at Arlington to the naval radio station at Mare Island, Cal., a distance of about 2,500 miles. All that was necessary to carry on this transcontinental wireless telephone conversation, he said, was to connect the receiver and transmitter apparatus of the special telephone outfit with the radio apparatus and send the message.

Captain W. H. G. Bullard, U. S. N., who is in charge of the Arlington station, and other officers of the navy conversed with officers of the navy on duty at the Mare Island yard in San Francisco.

The demonstration was the result of experiments that have been in progress for some time, and their success is expected to have a revolutionary influence on communication between American naval vessels and shore stations. By means of this perfected apparatus, which probably will be installed at all naval radio stations, it is expected that officers of the navy on land will be able to carry on wireless telephone conversation with officers at sea. Captain Bullard stated that the apparatus had been perfected to the point where a person on shore might carry on a long distance wireless telephone conversation with a friend on a transatlantic liner in mid-ocean, whenever shore station and liner were equipped with the necessary apparatus. In his formal announcement, Secretary Daniels said:

"I am pleased to announce the successful outcome of experiments which have been carried on for the last few months by the American Telephone & Telegraph Company and the Western Electric Company in co-operation with radio stations under the jurisdiction of the Navy Department by which long-distance wireless telephony has been made possible.

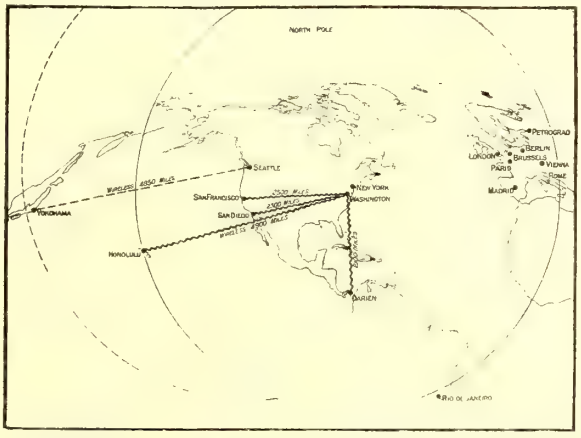
Speech has been successfully transmitted from the Arlington radio station to the radio station at Mare Island, Cal., and there successfully received, thus making possible conversation without wires over a distance of approximately 2,500 miles, the first time this great distance has been covered by wireless telephony. In the first experiments the voice was successfully transmitted by radio to Mare Island from Arlington, the return answers and communication being made over the transcontinental land telephone line. This was successfully accomplished in the presence of officials and engineers of the Western Electric Company, a representative of the Signal Corps of the army, representatives of the technical and operating departments of the Navy Department and a few other interested parties.

"After this successful demonstration, conversation originating in New York City was transmitted over the land wire to Arlington, there automatically connected to the radio transmitter which carried the voice to Mare Island, where it was clearly and distinctly received, and answers and other conversation were from there transmitted over the transcontinental line to the originating office in New York.

"The conversation was carried on by the president of the American Telephone & Telegraph Company, Mr. Vail; the vice-president, Mr. Bethell, and Mr. Waterbury, one of the directors, while at Mare Island were officials of the Navy Department, John J. Carty, chief engineer of the American Telephone & Telegraph Company, and representatives of the Western Electric Company.

"Every official taking part in this demonstration is enthusiastic about the results and the possibility of developing this system as an extension of the telephone system to ships at sea. The fact that the voices can be started on a land wire and automatically transmitted to a voice radio transmitter holds out hope that persons should readily be put in touch by telephone with others at sea through some central transmitting station.

"The use of such long distance wireless telephone communications in naval or military operations is still in an undeveloped state, but it is expected valuable use can be made of the wonderful demonstration; but aside from such considerations the department and its officials feel proud that they have been interested co-operators in the first practical development of this last march in the wonderful science of radio communication."



Radiotelephonic Range Chart, Showing How Speech Was Flung Through the Ether, 4,900 Miles From Washington to Honolulu, Corresponding to Distance Between Seattle and Yokohama.

The space through which the oral mes-

(*Continued on page* 369.)

Photographing Sound Waves Electrically

By Robert H. Moulton

The man who has had his troubles photographing an automobile traveling at the rate of 70 miles an hour, or about 100 feet a second, will best appreciate the difficulties faced by Prof. Albert F. Foley, of the University of Indiana, when he attempted to photograph a "sound wave." Professor Foley successfully accomplished the feat and, what is more, his pictures were sharp and clear, which is something that cannot be said of most photographs of automobiles going at full speed.

To emphasize the greater obstacles overcome by his methods, it may be stated that photographs of racing automobiles are usually taken at a distance of 50 feet or more and the cars, of course, may be plainly seen, while the objects photographed by this scientist were only 2 feet away from the camera and are moreover invisible to the naked eye.

His method of photographing sound waves was suggested by the "twinkling" light of the stars, a phenomena caused by the light passing through air layers of varying density, due to varying temperature; in reality the light of the stars is absolutely constant. In like manner sound waves in air are waves of condensation and refraction—that is, series of regions of varying air density. Since, then, the light from a star will be bent from its straight line path when it passes through such region, Professor Foley reasoned that sound waves produced between a point source and a photographic plate should cast shadows on the plate. The only thing necessary then is to photograph this shadow.

While this sounds simple and easy enough, it must be remembered that a sound wave travels at such great speed (or 1,125.69 feet per second at 20 deg. Centigrade) that in order to secure a sharp image of its shadow the light illuminating this shadow must not last longer than *one-millionth of a second.* Moreover, while the light does last, it must be *a thousand times* as strong as the light ordinarily employed in taking a photograph with a camera whose shutter works at a speed of one-thousandth of a second, and it must be turned on at *exactly* the right time or the sound wave will be out of range of the photographic plate.

Professor Foley arranged a large electrical machine capable of producing an almost continuous stream of electric sparks a foot or more in length, and each of such energy that is caused a loud report. In the circuit through which the sparks were to pass he made two spark gaps or breaks and in front of the first gap, nearest the electrical machine, placed his camera containing the photographic plate.

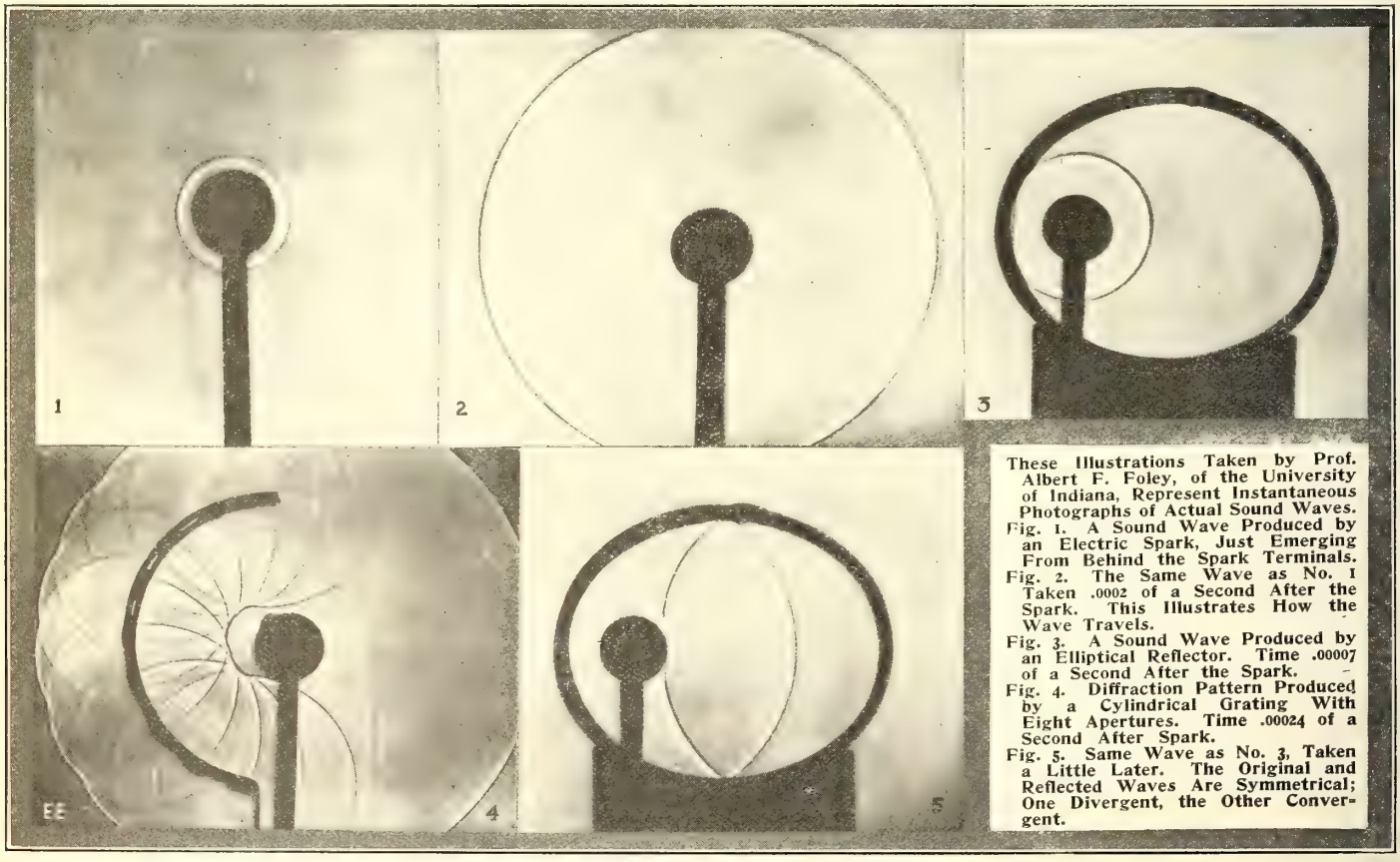
The action that results when a spark passes through the circuit may be described as follows: At the first gap the spark generates a sound wave directly in front of the photographic plate.

By the time that the sound wave has traveled outwards a few centimeters from the source the second or illuminating spark occurs at the second gap. The light from this spark is refracted as it passes the sound wave on its way to the photographic plate, thus throwing a shadow of the sound wave on the plate. To make the light of the illuminating spark sufficiently intense to give a clear image on the plate the electric charge is first stored in a large capacity of Leyden jars charged to a high potential, and then discharged between magnesium terminals placed in a glass tube like a short gun barrel, to direct the light, toward the plate. The details of this process are given below.

This physicist has a remarkable collection of these sound wave photographs, which show the waves in the process of being reflected from plane and curved mirrors, being brought to a focus by convex lens and made divergent by concave lenses, and, in fact, doing everything demanded by the sound wave theory.

The sound wave is produced by an electric spark gap S, which will be called the sound gap. The light is produced by a second spark at the illuminator gap I, which will be called the light gap. If the sparks at I and S are simultaneous the light I passes S before the sound wave emerges from behind the spark terminals. If the time interval between the sparks is any considerable fraction of a second the sound wave at S passes out of the field before the light from I reaches S. But when the interval between the two sparks is properly timed the sound wave at S casts its shadow on the photographic dry plate P.

The spark gaps S and I are connected in series to the spark knobs K, K_0, which receive sparks from T, T_0, the terminals of a large electric induction machine having four rotating mica plates 30 inches in diameter, driven by a variable-speed electric motor. The length of the spark gaps T-K and T_0-K_0 is adjusted by sliding T and T_0 horizontally, or by moving K and K_0 vertically. Glass plates G and G_0, about 20 centimeters square, are fastened to a wooden bar on rod R, arranged so that it can be rotated on a horizontal axis. In the position shown in the figure the plates are directly between the spark knobs T and K and T_0 and K_0, thus preventing a spark. A quarter turn of the handle rod R removes the plates and allows the spark to pass. In practise, however, it was found best to make the spark gaps T-K and T_0-K_0 just long enough to prevent sparking when the glass plates are out of the field.



These Illustrations Taken by Prof. Albert F. Foley, of the University of Indiana, Represent Instantaneous Photographs of Actual Sound Waves.

Fig. 1. A Sound Wave Produced by an Electric Spark, Just Emerging From Behind the Spark Terminals.

Fig. 2. The Same Wave as No. 1 Taken .0002 of a Second After the Spark. This Illustrates How the Wave Travels.

Fig. 3. A Sound Wave Produced by an Elliptical Reflector. Time .00007 of a Second After the Spark.

Fig. 4. Diffraction Pattern Produced by a Cylindrical Grating With Eight Apertures. Time .00024 of a Second After Spark.

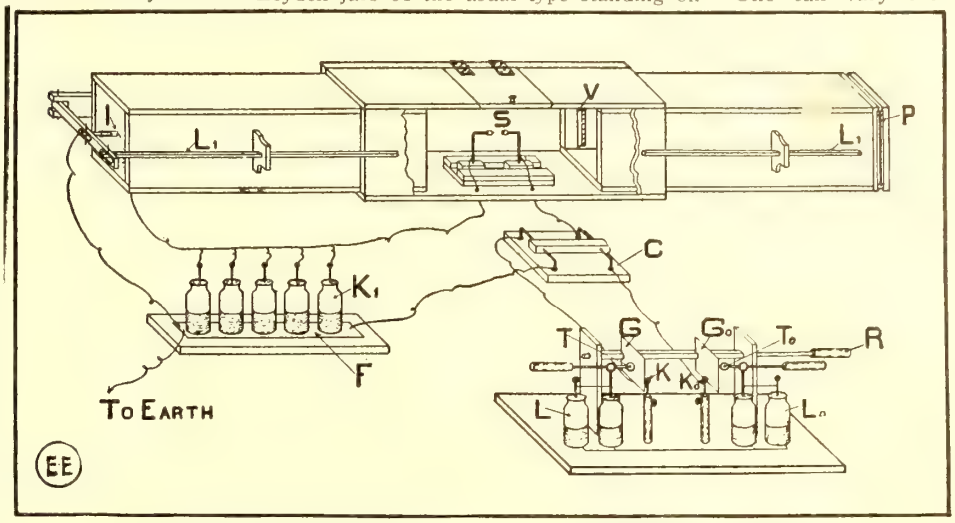
Fig. 5. Same Wave as No. 3, Taken a Little Later. The Original and Reflected Waves Are Symmetrical; One Divergent, the Other Convergent.

Rotating the rod then causes a spark just as the edges of the plates pass through the gaps.

To get a strong sound wave at S and an intense light at I, the sparks to the knobs K, K_0 should be heavy; consequently from one to three Leyden jars L, L_0 are put in multiple with each of the jars on the machine itself. Most of the work is done with one additional jar connected to each of the machine jars.

The knobs K. K_0 are connected to the gaps S and I through a large commutator C. Thus the direction of the spark at the gaps is readily changed. It was found that the apparatus worked about equally well with the spark in either direction. The chief effect of reversing the spark direction appeared to be a slight change in the time intervals of the sound and light "sparks."

The sound gap S is in series with the light gap I, nevertheless the spark at S occurs before the one at I, because of the capacity K, which is in multiple with the gap I, as shown in the figure. The capacity K_1 consists of from two to eight Leyden jars of the usual type standing on a sheet of tinfoil F, with one coating connected to earth. The time interval between the sound and light sparks depends on the capacity K_1, the greater the capacity the greater the interval. However, it is not at all necessary to have here a variable condenser or one made up of small units. One can vary the capacity K_1 between rather large limits and still keep the proper time interval by varying the circuit in other ways. The time interval is increased by decreasing the capacity L, L_0; by decreasing the length of the spark gaps T-K and T_0-K_0. One can vary the capacity K by 100 per cent. and readily maintain an approximately constant time interval between the sound and light sparks by merely changing the length of the light gap. The length of this gap is adjusted by the lever arrangement L_1, L_1.



Layout of Apparatus Used by Prof. Foley in Photographing Sound Waves.

DANIELS NAMES NAVAL ADVISERS.

The make-up of the Naval Advisory Board of Inventions, the organization of experts who will contribute their inventive genius to the navy, of which Thomas A. Edison is to be the chairman, was announced by Josephus Daniels, the Secretary of the Navy, on Sept. 12 last.

The board will consist of 23 members, including Mr. Edison, who was selected by Mr. Daniels to serve as the presiding officer of the board.

The other 22 members of the board, who were chosen by ballot by 11 of the principal scientific societies of the country whose members deal with those branches of science on which the navy is thought to be dependent for invention, are:

W. R. Whitney, L. H. Baekeland, Frank Julian Sprague, Benjamin G. Lamme, R. S. Woodward, Arthur Gordon Webster, A. M. Hunt, Alfred Craven, Spencer Miller, William Le Roy Emmett, Matthew B. Sellers, Hudson Maxim, Peter Cooper Hewitt, Thomas Robbins, Howard E. Coffin, Andrew J. Riker, Henry A. Wise Wood, Elmer A. Sperry, William L. Saunders, Benjamin B. Thayer, J. W. Richards and Lawrence Addicks.

The first general meeting of the board was called on Wednesday, Oct. 6, in the office of Secretary Daniels in Washington.

In announcing the names of the members of the board Secretary Daniels made the following statement:

"Desiring to make available the latent inventive genius of our country to improve our navy, a short while ago I requested Mr. Thomas A. Edison to become chairman of an advisory board of eminent men who would make up the board. Mr. Edison, with the patriotism characteristic of American inventors, accepted the call to duty. The plan adopted for selecting the members of the advisory board was as follows:

"I requested 11 great engineering and scientific societies to select by popular election two members to represent their society on the board. The result has been most gratifying. I have received the nominations of all these societies and have accepted them, and it only remains to have a meeting, organize and determine the method of procedure in order to utilize to the best advantage of our navy this mobilization of the talent and genius of our country. The response of the societies invited to co-operate in the great undertaking indicates the patriotic enthusiasm awakened by this call to duty."

Personnel of the Board.

These are the members selected by the societies and accepted by the Secretary:

American Chemical Society—W. R. Whitney, Schenectady, N. Y.; Massachusetts Institute of Technology, '90; director of research laboratory of the General Electric Co., where he has been the moving spirit in the perfection of metallic electric lamp filaments and the development of wrought tungstens. L. H. Baekeland, Yonkers, N. Y.; University of Ghent, '82; in private practice; founder of the Nepera Chemical Co., 1892, and inventor of photographic paper.

American Institute of Electrical Engineers—Frank Julian Sprague, New York City; Naval Academy, '78; consulting engineer for Sprague, Otis and General Electric companies; founder of the Sprague Electric Railway Motor Co. and concerned in establishing first electric trolley systems in the United States. B. G. Lamme, Pittsburgh. Ohio State, '88; chief engineer of Westinghouse Electric and Manufacturing Co, and a prolific inventor.

American Mathematical Society—Robert Simpson Woodward, Washington, D. C.; Michigan, '72; president of Carnegie Institution and an authority on astronomy, geography and mathematical physics. Arthur Gordon Webster, Worcester, Mass.; Harvard, '85; professor of physics of Clark University and an authority on sound, its production and measurement.

American Society of Civil Engineers—Andrew Murray Hunt, New York City; Naval Academy, '79; consulting engineer; experienced in the development of hydroelectric, steam and gas plants. Alfred Craven, New York City; Naval Academy, '67; chief engineer of Public Service Commission and formerly division engineer in charge of construction work on Croton Aqueduct and reservoirs.

American Aeronautical Society—Matthew Bacon Sellers, Baltimore, Md.; Lawrence Scientific School; director of Technical Board of the Aeronautical Society of America, and first to determine dynamic wind pressure on arched surfaces by means of "wind funnel." Hudson Maxim, Brooklyn, N. Y.; ordnance and explosive expert and maker of first smokeless powder adopted by the United States Government.

The Inventors' Guild—Peter Cooper Hewitt, New York City; inventor of electric lamp appliances to enable direct current apparatus to be used with alternating current circuits, and devices for telephones and aircraft. Thomas Robbins, Stamford, Conn.; Princeton; president of Robbins Conveying Belt Co. and inventor of many devices for conveying coal and ore.

American Society of Automobile Engineers—Andrew L. Riker, Detroit; vice-president of the Locomobile Co.; electrical and mechanical engineer and inventor of many automobile devices. Howard E. Coffin, Detroit; Michigan, '96; vice-president of the Hudson Motor Car Co. and active in the development of internal combustion engines.

American Institute of Mining Engineers—William Laurence Saunders, New York City; Pennsylvania, '76; chairman board of directors of the Ingersoll-Rand Co. and inventor of many devices for subaqueous and rock drilling. Benjamin Bowditch Thayer, New York City; Harvard, '85; president of the Anaconda Copper Mining Co. and an authority on explosives.

American Electro Chemical Society—Joseph William Richards, South Bethlehem, Pa.; Lehigh, '86; professor of electro chemistry, Lehigh University, and author of numerous works on electro metallurgy. Lawrence Addicks, Chrome, N. J.; Massachusetts Institute of Technology, '89; consulting engineer for Phelps, Dodge & Co. and an authority on the metallurgy of copper.

American Society of Mechanical Engineers—William Leroy Emmet, Schenectady, N. Y.; Naval Academy, '81; engineer with the General Electric Co.; designed and directed the development of the Curtis turbine; first serious promoter of electric propulsion for ships. Spencer Miller, South Orange, N. J.; Worcester Polytechnic, '79; inventor of ship coaling apparatus and the breeches buoy device used in rescues from shipwrecks.

(*Continued on page 364.*)

Some New X-Ray Apparatus

SEVERAL new X-ray apparatus have been recently developed and perfected whereby the efficiency of this electrical aid to surgery and medical men has been vastly increased. A number of these up-to-date X-ray apparatus will be described in this article.

One great difficulty in the generation of high voltage currents by an induction coil

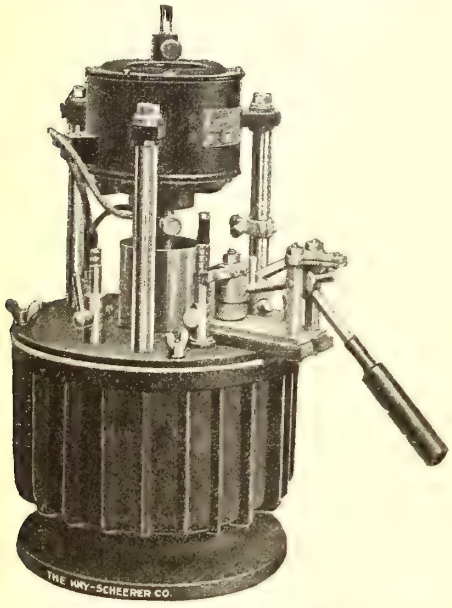


Fig. 1. Improved Type of Mercury Jet Interrupter.

or transformer for X-ray requirements lies in the device which produces the current interruptions when operated on direct current. Various types of interrupters have been built for this purpose, but none of them have proved very efficient. One of the latest interrupters of the improved mercury jet type and which employs illuminating gas for a quenching dielectric is depicted in Fig. 1. This particular interrupter consists of a small rotary pump, which throws a stream of metallic mercury against contact segments. The arc which is formed upon the break at the contacts is quenched by the gas, which is sent through the chamber. A condenser, of suitable capacity, is shunted across the interrupter terminals. The number of breaks per second can be regulated by varying the speed of the motor and also by the adjustment existent between the rotary and stationary segment.

A highly efficient heavy current chemical transformer (really an electrolytic rectifier) is portrayed at Fig. 2. This constitutes an ordinary rectifier of this class, employing extra large iron and aluminum plates immersed in an electrolyte of sodium phosphate (or bicarbonate of soda may be used). These chemical transformers can be satisfactorily employed in places where direct current is required, when A. C. is supplied from power companies' mains.

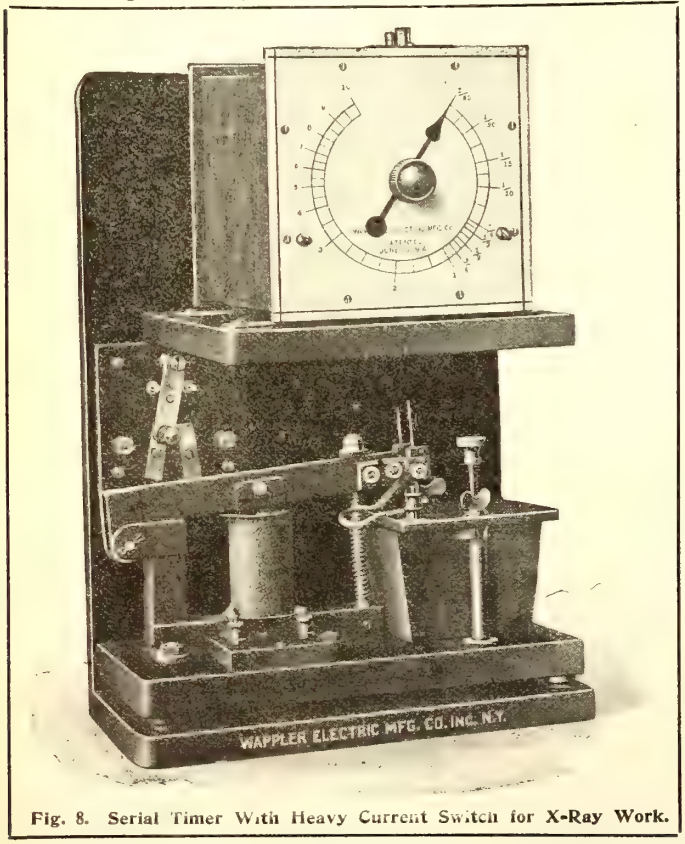


Fig. 8. Serial Timer With Heavy Current Switch for X-Ray Work.

These large rectifiers are inserted in the primary circuit of large (3-5 kw.) X-ray transformers to clip off half the cycle waves of the alternating current and thus produce in the secondary circuit a unidirectional or direct current of high potential. In other words, the negative pulses of current in the primary circuit are clipped off by the rectifier and pulses of positive current only are allowed to pass through the transformer. This does not give a true unidirectional or D. C. in the secondary, but by interposing high potential rectifier tubes in the secondary circuit before the current reaches the X-ray tube the much-desired high tension direct tube current is approximately developed. In the large machines pure direct current at 100,000 volts is produced by a revolving commutator of special design.

Another problem met with in the continuous production of X-rays is the generating tube itself, which becomes extremely hot when operated for periods of several minutes or even seconds; this is mainly due to the rapid ionic bombardment acting on the Anode electrode. Various shapes and sizes of Anodes and tubes were made to help eliminate this defect, but none of them have proven very beneficial, until the water-cooled Anode tube was devised. This is illustrated in Fig. 3, together with its water circulating apparatus. This consists of an electrically-driven pump built into a large water tank, to which two rubber tubes are connected from the tube, one for feeding in the water and the other for discharging it.

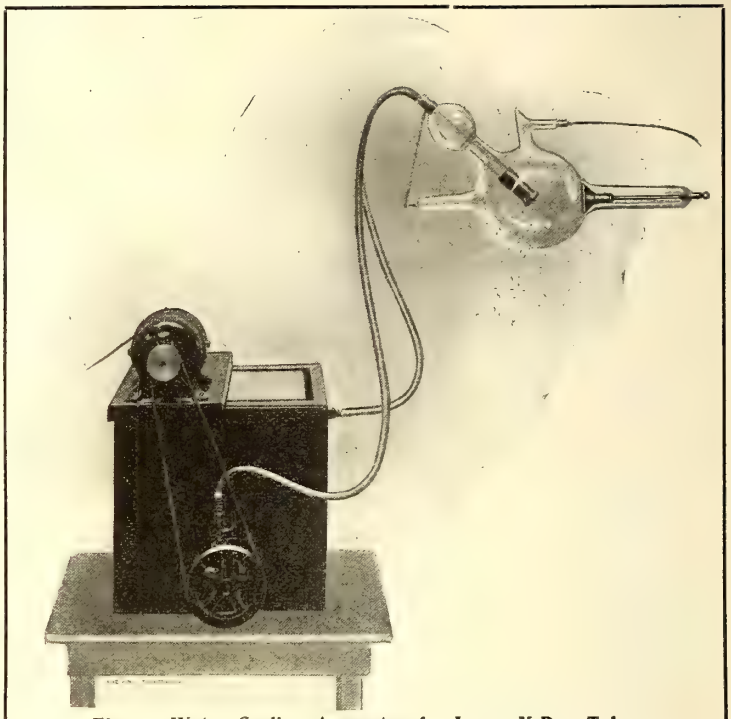


Fig. 3. Water Cooling Apparatus for Large X-Ray Tubes.

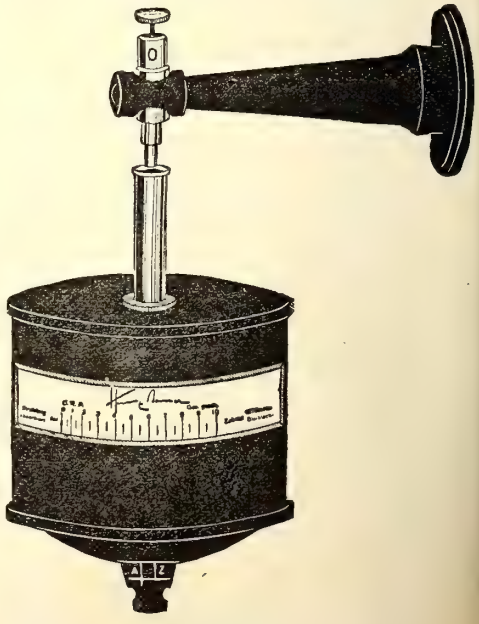


Fig. 5. Electro-Static Type of X-Ray Penetrometer.

In this way the Anode is constantly cooled by the circulating liquid. This scheme has showed remarkable results in allowing the tube to be manipulated for several minutes,

at full load, which often means 15 to 25 kilowatts.

A recent very neat instrument has been designed whereby the penetration of the X-rays through silver is taken. It is well known that these rays do not penetrate this metal appreciably and consequently a "meter" for measuring the *penetration of X-rays* has been invented. It is shown in Fig. 4, and is called technically a "Penetrometer." This instrument consists of a standardized tapered piece of silver, mounted on a lever which is movable in front of a fluorescent screen by means of a rack and pinion operated by a small knob in front of the instrument. A small graduated aluminum scale is provided so as to show exactly the penetration of the particular X-ray measured. The distance between the tube to be tested and the Penetrometer, at which readings are taken, is immaterial, as the radiance at a given distance has an even influence through the silver and aluminum; however, as a rule 12 inches from the wall of the tube allows the quickest readings. Another instrument for measuring the penetrating power of the rays is depicted in Fig. 5, but this is graduated in different units and is operated by a single wire, connected to the cathode terminal of the high tension machine. This is a different instrument than the one previously described, as the former depends upon the secondary voltage produced by the transformer. Inasmuch as the penetrating power of the tube depends upon the voltage, this instrument will show exactly the penetration of any particular X-ray tube.

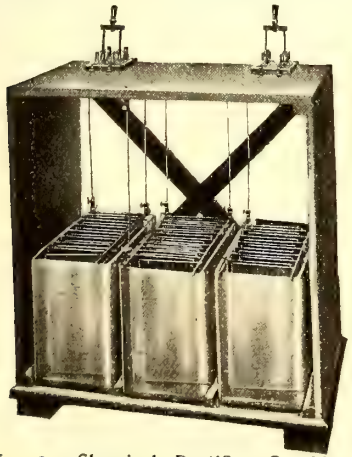


Fig. 2. Chemical Rectifier Capable of Handling Several Kilowatts.

We present two exceptionally good skiagraphic pictures which have been taken with different X-ray tubes. Fig. 6 shows the bare foot of a woman. Note the wonderful clearness of the bones and the fibrous structure of same; while Fig. 7 portrays X-ray photo of the right foot of a man, with shoe on, as will be readily perceived. Note the appearance of the skin of the foot in comparison with the leather of the shoe. Also observe the nails, the arch, lace tips and eyelets. This picture was taken with a ¾ second exposure; distance between tube and plate was 18 inches, while the tube was carrying 40 milliamperes of high potential direct current. The latter skiagraph was taken by Harry F. Ernest, the expert radiographer of the Kny-Scherer Co.

The illustration at Fig. 8 is of a new X-Ray serial timer, which will be found very useful to the medical profession engaged in making numerous skiagraphs. The timing of such X-Ray photos is very important. The dial indicator of this new instrument may be placed on any exposure time from 1/60 of a second to 10 seconds.

The Repeating Serial Timer is made up of an actuating mechanism which permits a pair of contacts to close an electric circuit through a magnet, and remain closed for a predetermined length of time, this being accomplished by the magnet pulling a pair of large contact surfaces together, closing the circuit through the transformer. At the expiration of the predetermined length of time the first circuit breaks, the magnetism collapses and the large contacts are separated by a strong spiral spring.

Fig. 6. Below: Skiagraph of Left Foot of a Woman. Such X-Ray Photographs Enable the Physician to Diagnose a Case Quickly and Correctly. Note That the Structure of the Bone Proper Is Observable in This Excellent Skiagraph.

Fig. 7. The Upper Skiagraph Depicts a Sidewise X-Ray View of a Man's Foot With Shoe On. Observe Particularly the Shoe and Flesh Outline; Also the Steel Brace in the Sole, as Well as the Nails. The Metal Eyelets and Cord Tips Show Up Plainly. This Picture Was Taken in ¾ Second, the Foot Being Placed 18 Inches From the X-Ray Tube.

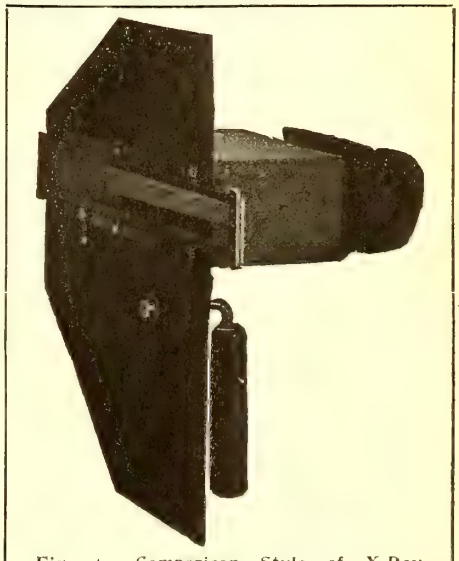


Fig. 4. Comparison Style of X-Ray Penetrometer.

READING ELECTRIC METERS WITH A CAMERA.

The truth-telling camera has found another and highly practical field of usefulness. Electric meters, gas and water meters will in future be photographed instead of read and and in place of figures furnished by sometimes very fallible inspectors a film record will supply authentic confirmation of the charge. This method of reading will also be much quicker and, with all possibility of error removed, a great saving in the time of inspectors and clerks as well as of consumers over disputed accounts will be effected.

A camera for the purpose has just been invented by the Eastman Kodak Co., and is known as the "Factograph." This novel camera is oblong in shape, measuring 4½ x 5¾ x 12½ inches—is made from selected mahogany, is equipped with a high grade anastigmat lens working at f.6.3 and a simple automatic shutter permitting exposures varying from 1/5 to ½ a second—within the judgment of the operator.

The camera is made in two compartments—the forward compartment being an electrically lighted chamber with an opening that fits over the meter dial. The reading is made by simply placing this opening against the meter and pressing downward on the exposure lever.

This one action automatically turns on the light, opens and closes the shutter and turns off the light. The shutter with each exposure locks automatically and remains locked until film for the next exposure has been wound into place, when it again flies automatically back to the "set" position.



Sample of Film Record as Taken by New Electric Meter Camera.

This prevents the possibility of a double exposure—likewise there can be no blanks, for the film cannot be wound off until the exposure is made. Winding reel and shutter are automatically unlocked. This eliminates the possibility of error from forgetting to turn the key or from turning the key before the exposure is made. The light



How the New Electrically Lighted Meter-Reading Camera is Used.

is furnished from two four-cell dry batteries stored on either side of the camera and supplying current to four 3.8 volt Tungsten miniature lamps.

The exposure is recorded upon special, sensitized paper; a special film or paper is supplied in the familiar cartridge form and is daylight loading—each cartridge carrying 75 exposures.

Storage space for two extra rolls is provided in the dark chamber of the camera in addition to the roll in position, permitting 225 readings to be carried within the body of the camera. A small drawer is provided in front which carries six extra lamps.

By pressing a small button which is located just below the exposure lever the lights may be turned on and the camera converted into a "flasher" for locating meters or finding one's way through dark cellars.

Special developer, furnished for the purpose, makes it possible to develop the film in 45 seconds. It is then ready for the reading by the bill clerk. No printing is necessary. The spools of film are opposed to a tiny mirror reeled up like a movie film, the clerk copying the records as they are mirrored. Identification of each meter is made possible by attaching the name and number to the meter. These are photographed with the meter reading.

In residence sections, through absence of the household, inspectors are frequently unable to gain access to the meters on the first call. For such contingencies cards are provided with the word "out" printed upon them. This card is photographed in place of the meter record and the information appears on the film in its proper order.

MISHAPS ATTEND USE OF WIRELESS ON AEROPLANES.

It has already been noted in many official and unofficial despatches that wireless telegraphy is frequently used both by the Royal Flying Corps and the Royal Naval Air Service. Most people are used to seeing wireless apparatus, which, whether used on board ship or on land, includes a series of long wires strung between masts or attached to a long pole in the ground.

These generally take the form of a single long wire on aeroplanes, which, when not in use, is wound up on a reel like the reel of a fishing rod, inside the machine. When it is intended to operate the apparatus the aerial is let out, the initial impetus being given to it by a lead weight like a plumb bob attached to the end.

Several hundred feet of this wire are let out, and it assumes a most curious shape in the air, because the weight of the plumb bob and of the lower portion of the wire naturally endeavors to hang down straight, whereas the resistance of the air through which the aerial is dragged always tries to pull it out horizontally behind the machine, with the result that the wire assumes a curve stretching out some distance behind the machine itself, says the editor of *The Aeroplane,* London.

When several hundred feet of wire are out, the air resistance actually amounts to quite a considerable strain on the reel, and consequently on the machine itself, though it is generally attached so that it does not interfere to any considerable degree with the fore and aft or lateral control of the machine. If, however, the engine stops suddenly, and the pilot has to make a forced descent, his operations are occasionally complicated by the resistance of the wire, which then is apt to act something like a brake on the machine's gliding path downward, unless it can be wound up fairly quickly.

In one case an officer who was experimenting with wireless as a passenger on a machine so fitted was quite badly knocked about owing to the necessity for winding in the wire. He was quite an experienced flyer, and had made a study of the best way to behave in case of an accident. In several such cases he had come out unhurt by the simple process of tucking his feet up onto the seat and rolling himself up as nearly into the shape of a ball as possible, so that when the machine turned head over heels he went over with it and his feet were not trapped by the front part of the machine breaking back on top of them.

In this particular instance he was so full of his duty that he went on winding away at the reel till the machine actually struck the ground. He had been obliged to steady himself with one foot against the floor of the front of the machine and wind up the reel on the left-hand side of the machine with his right hand. Consequently when the machine struck he pitched with all his weight onto his foot and was flung forward with his right arm against the front of the bodywork, the resulting damage being a broken leg and a broken arm. He has since concluded that under similar circumstances it is wiser to let the wire alone when he is near the ground and hope that it will catch in a tree or a hedge and break.

MASSIVE ELECTRIC GENERATOR HOLDS AUTOMOBILE.

The illustration shown herewith depicts an extra large electric dynamo built for one of the great automobile factories in Detroit. The massive size of this dynamo can be judged by the picture, which illustrates one of this concern's automobiles resting nicely on a scaffold in the center of the stationary field frame of the generator. This is one of several similar generators which will supply the current for the entire plant turning out these motor cars.



Huge Electric Generator Accommodates Automobile Within Its Field Frame.

MIND-READING DOG IS A PUZZLE TO SCIENTISTS.

DECLARED by Western scientists to be one of the most remarkable dogs on record, Hector, a little French poodle, owned by C. J. Tryon, a mining engineer, of Arizona, has opened the eyes of students of psychology to new possibilities of the animal mind. Only two years of age, this dog has been trained not only to add, subtract, multiply and divide, but also to read the mind of his master, this being done, as explained by Professor C. L. Edwards, head of nature study work in Los Angeles schools, by the joint powerful concentration of both dog and man.

Numerous demonstrations have satisfied skeptical ones that there is no trick connected with the evidence of the dog's mental development, and investigators have come away with the conviction that, properly trained, the dog is a wonderful thinking and reasoning animal.

It was through reading an article by Maetterlinck, on the scientific mental training of horses in Germany, that Mr. Tryon conceived the idea of experimenting with the poodle he purchased in Los Angeles. He began by teaching the animal ordinary balancing tricks, and then finding Hector not only attentive and obedient, but a remarkably apt scholar, began to devote his time to the dog's mental training. It required patient drilling, but the results astounded him, for in a short time Hector was not only able to grasp the meaning of more than one hundred words and to obey their command with the proper action, but he showed evidence of being able to carry more than one idea or thought in his mind at the same time. "Hector, roll over!" Mr. Tryon would command, and Hector would proceed to do so. Then his master would order him to "roll over, sit up, shake your paws and bark," and after a little drilling the dog would perform all acts in their proper sequence. Once learned, an act, mental or physical, was never forgotten.

The dog's mathematical ability came merely as a matter of learning to distinguish and to apply on command the words "one," "two," "three," and so forth, just as he had learned to distinguish between "sit up" and "roll over," or between "pull it over" and "push it over." At the command "Count one!" Hector would be shown to tap a bell with his paw, once. At first the word "one" meant nothing, but after being stopped on the first ring of the bell he soon took note and tried to catch the word. At "Count two!" he would have to strike the bell twice, and these commands would be repeated until he mastered them.

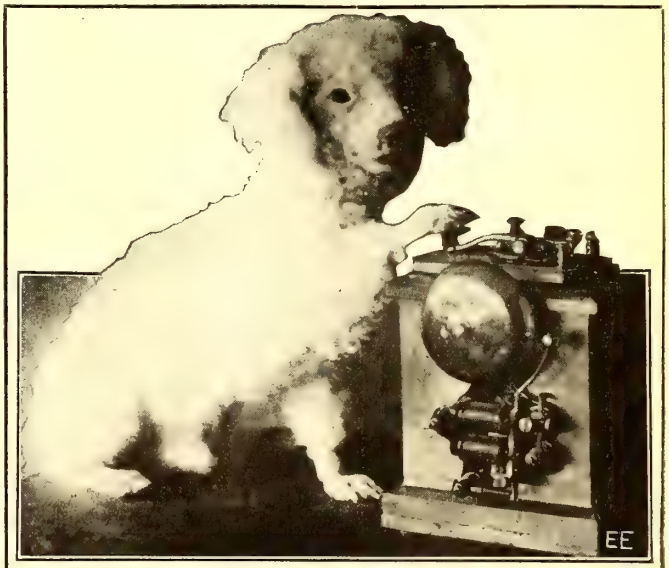
Then came the combinations, "two plus two." It required patient, laborious effort on the part of his teacher, but gradually the little poodle learned to tap the answer for any plus combination that did not exceed twenty-five in total. Whenever he erred on any particular combination he was corrected immediately, and made to tap the right answer several times in succession, after separate commands, before any further progress was attempted. Hector simply learned that the command "Count two plus seven!" meant nine taps of the bell, just as he had learned that "sit up" and "roll over" meant a certain act on his part.

Mr. Tryon explained some of his methods and the success he has met with as follows:

"To start with," he said, "Hector has perhaps no more wonderful brain than a great many other dogs, but he has had the advantage of scientific training. From observations and experiments I had long become convinced that dogs could think and reason, and I was determined to prove it. Finding Hector, like most poodles, very attentive and ready to concentrate his whole thought on every word spoken, I put forth every energy in his mental development. It became a hobby of mine, and I thoroughly enjoyed what would perhaps tax the patience of the average man.

"Physiological experiments prove that the principal parts of a dog's brain are relatively located and have the same function as the human brain. Like humans, different dogs have certain well defined talents which can be developed to a remarkable extent by continued training, providing, of course, that the dog has real brain capacity. Some humans cannot learn anything, and some dogs are the same way—naturally without brain capacity."

Recently Mr. Tryon has discovered that his French poodle has a remarkable faculty for reading his thoughts. Not being a student of mental telepathy, Mr. Tryon is at a loss to explain it, but on many occasions he has concentrated his thoughts on a certain number and, fixing his gaze on Hector, has silently commanded him to "count" that number. And Hector has invariably approached his tapping bell and counted the number correctly.



"Hector," the Dog That Taps an Electric Bell Intelligently, It Is Said.

High Frequency Currents and Apparata

EVER since 1891, on which memorable date Nikola Tesla, the wizard of high frequency electrical phenomena, delivered his famous lecture before the American Institute of Electrical Engineers covering his discoveries and experiments in

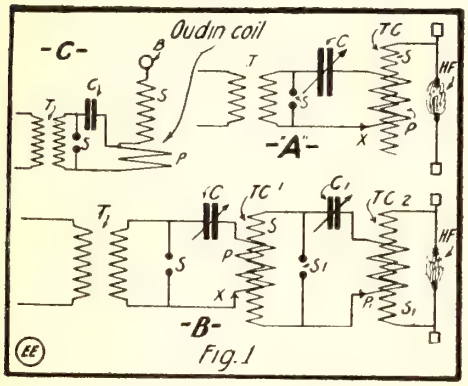


Fig. 1. Diagrams For Oudin and Tesla Coil Hook-Ups.

this wonderful field of science, the greatest scientists of the whole world have been busily occupied in developing and perfecting apparatus of this nature for various purposes, including invaluable electro-therapeutical applications, wireless telegraphy, etc. Possibly the electro-medical profession has benefited more by the discoveries in this little known field of electrical science than any other branch of workers.

In this article will be outlined a few of the more interesting arrangements and types of apparatus which can be employed for the production of ultra-high frequency, high potential electric currents, and which, as is generally known, can be taken through the body without feeling any appreciable pain. It is these high frequency currents, which oscillate at anywhere from 100,000 up to 1,000,000 or more times a second, which are utilized in the many electrical stage acts touring the country and which probably most readers have seen at some time or other. The apparatus described in this article produces high frequency currents of th's character, and many pleasing, startling experiments can be made therewith, similar to those shown by the stage lecturers and college professors.

At Fig. 1 there are outlined at A, B and C the principal hook-ups and layouts of apparatus necessary for the production of these ultra-high frequency currents. At Fig. 1A is depicted the regular Tesla coil circuits with a step-up transformer, T, spark gap S, glass or other high tension

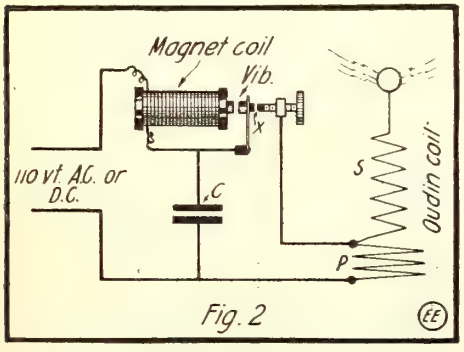


Fig. 2. Collins-Sanchez High Frequency Generating Circuit.

condensers C, preferably of the adjustable type, and TC the air-core Tesla transformer. At P the primary of this Tesla coil is indicated, while at S is shown the secondary winding. The high frequency current discharges take place between the electrodes at HF. To properly tune the closed oscillating circuit SCP the condenser C should be made adjustable as aforementioned, and also the primary inductance P should be variable by means of a clip X. This permits the capacity and the inductance of this circuit to be altered until maximum results are obtained in the Tesla coil secondary.

In some cases resort is had to a compound Tesla circuit as depicted in Fig. 1B. Here the usual step-up transformer excites the circuit SCPX. The secondary S of Tesla coil TC¹ then charges or excites the second closed oscillatory circuit S¹C¹P¹, the final high frequency discharge taking place from the secondary S¹ of the No. 2 Tesla coil.

Where a discharge of great intensity is desired the usual hook-up for a high frequency outfit is indicated at Fig. 1C. Here the same symbols refer to similar parts as just explained, and for this Oudin coil arrangement one end of the secondary S is joined to the primary coil P; the other end of the secondary coil is connected to a brass or copper ball B. This scheme is different from those shown at A and B, Fig. 1, in that the secondary is placed at the end of the primary and not inside of same, as is the case in the regular Tesla coil arrangement.

While on the subject of high frequency schemes and circuits for same, it will undoubtedly be of interest to cover one of the latest plans for this kind of work, or the Collins-Sanchez high frequency generating circuit, as outlined in Fig. 2. This constitutes the idea now utilized in a large majority of the extra compact style high frequency sets supplied for physicians' requirements, etc. To begin with, a small-size and very well-insulated Oudin coil consisting of primary and secondary P and S is made use of. The secondary, as understood from diagram at Fig. 1C, connects to a metal ball or other electrode as observed, and its other free terminal is joined to the primary P. High frequency currents are caused to be generated and to oscillate around the circuit CXP, which comprises a mica or other fairly high voltage condenser C, a vibrating spark gap X and the primary coil of the Oudin transformer P. The vibrator X carries extra heavy silver contacts and the iron armature of the vibrator spring is attracted by the magnet coil as perceived. Thus this vibrator performs two functions, viz., it serves to interrupt its own (magnetic coil) circuit as supplied with current from 110-volt direct current or alternating current, and also it serves as a spark gap for the high frequency oscillating circuit CXP. These high frequency currents thus produced are transformed by induction into the secondary circuit of the Oudin coil S. This type of apparatus gives a very powerful and steady uni-polar discharge, and the current thus generated is much in use nowadays for ultra-violet ray treatment, excitation of X-ray tubes, etc.

A great many experimenters possess a high voltage wireless transformer rated at ½ kw. or more and giving anywhere from 12,000 to 15,000 volts at the secondary terminals. For those possessing such a transformer, and also for those who may be interested in building a fair-size high frequency outfit and who can easily purchase a suitable transformer of the size aforementioned, the following data is suggested. The Tesla coil here described will produce

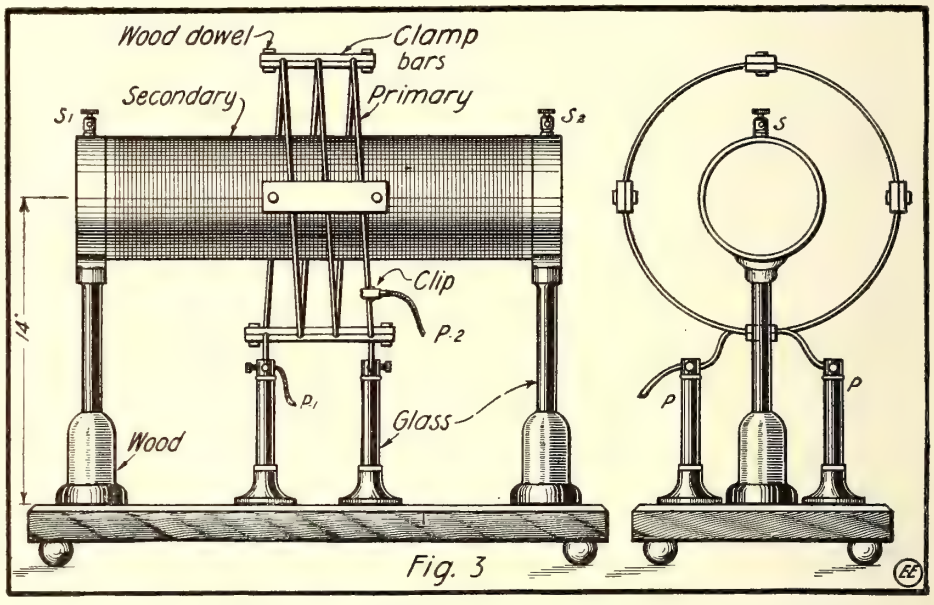


Fig. 3. A Well Designed Tesla Coil, Suitable for Use on ½-Kw. High Potential Transformer.

12 to 15-inch high frequency sparks from the secondary when excited by a transformer of the type just mentioned.

Besides the transformer in question, there will also be required a suitable glass plate condenser or the equivalent made up of Leyden jars, and also a spark gap, which shall preferably be of the rotary type so as to be well cooled. A quenched spark gap proves very efficient for this class of work.

Fig. 3 shows the appearance of the Tesla coil design here proposed. The base of same may be made of some well-dried wood, and th's had best be boiled in paraffine wax so as to exclude all dampness. Upon this base are placed glass supporting rods for the secondary and primary coils, and this will be found to give the very best efficiency where such high frequency, high potential currents are to be produced.

The primary coil is composed of four to six turns of about No. 4 B. & S. copper, brass or aluminum wire (stranded best), and these convolutions of heavy wire are wound to a diameter of about 12½ inches, spacing the turns about 1½ inches apart.

The primary turns are held in shape by four wax impregnated wooden clamps, as perceived. Also a clip is provided for one lead of the primary so that the number of turns in circuit, and consequently the inductance, may be varied in tuning up the set.

The secondary coil may be composed of a cardboard cylinder 24 inches long by 5 inches in diameter. This is provided with two binding posts at the end of same, as shown, and the winding comprises one even layer of No. 26 enameled or silk-covered magnet wire, each turn being spaced from its neighbor the thickness of the wire itself to improve the insulation. This can be done easily in a screw-cutting lathe.

This coil should be hooked up as per diagram, Fig. 1A. Regarding the glass plate condenser suitable for this ½-kw. size high frequency coil, and considering that the exciting transformer is rated at 12,000 volts (secondary), with a frequency of 60 cycles, then .06 microfarads condenser capacity is required. If ⅛-inch common glass is used in making this condenser about 5,333 square inches of such glass is required. This is coated on both sides with tin-foil; 1½ inches margin should be allowed around every tin-foil leaf on the glass plates. If the foil can be made 24x20 inches on each plate, then 11 such plates will be necessary for this outfit.

At Fig. 4 are shown a number of details which can be followed more or less exactly in making up a suitable condenser rack to hold these glass plates. This rack may be made up of wax impregnated wooden pieces, and inside of same there are placed two hard rubber strips in either side of the frame, which strips are slotted as perceived, so that the glass plates may rest edgewise in these slots, thereby reducing current leakage to a minimum. By looking at the top view of the condenser frame it is seen that two metal strips run along the top hard rubber strips and a series of binding posts are mounted on these metal pieces. From each bindng post there runs down between the glass plates a brass wire carrying a spring contact shoe, detail of which is shown in sketch at Fig. 4. It is thus perceived how each alternate foil-leaf on the glass plates receives a positive and negative charge. The terminal lead wires T1 and T2 should be hooked up to the condenser frame as in diagram, i. e., to opposite end of the metal strips, so that the high frequency inductance will be balanced, no matter how many condenser plates are in use. The number of plates in use can be varied by simply sliding them out of the rack, or also by removing one or more of the spring contact shoes.

Regarding the details of rotary spark gap suitable for this outfit, they are illustrated at Fig. 5. Any small motor operating on battery or 110-volt current is to be utilized in driving the rotary spark disc B. This disc is made up in the regular fashion as employed for wireless sets, but the plan here advocated is a very good one, especial- from the air-cooling point of view.

This design calls for a ⅛-inch zinc or other metal disc about 6 inches in diameter, and 12 spark plugs are cut into the disc as detail sketch B portrays. These sparking electrodes are cut on three sides and then the lug is bent up. All of these lugs when finished should be filed off or turned off in a lathe, so as to be perfectly true. This operation, however, had best be postponed until the disc is firmly screwed or riveted to a central hard rubber insulating hub, as drawing shows. The spark disc is held securely to the motor shaft either by means of a regular hub or by means of hexagon nuts threaded onto the shaft. In front of the revolving spark wheel are mounted two stationary electrodes, and detail sketch A shows how the ends of these are filed down so as to correspond with the thickness of the rotating disc electrodes. It is well to force a few cooling vanes (washers) tightly on the ends of the stationary electrodes as indicated. A marble base is best employed for mounting the motor and stationary electrodes with their upright standards. There are thus two spark gaps in series in this design. It is well to have a rheostat in series with the spark gap motor, so that the speed of same may be adjusted, and also the spark frefrequency, in tuning up the complete high frequency sets.

When all of these parts have been properly made up or assembled and the diagram followed as per Fig. 1, there should be very little trouble experienced in producing a heavy high frequency spark 1 foot long or more, depending upon the adjustments of the circuit. The spark gap, condenser and primary coil clip X should be adjusted one after the other or alternately until the maximum resonance is obtained in the circuit as manifested by the production of the largest spark in the secondary circuit.

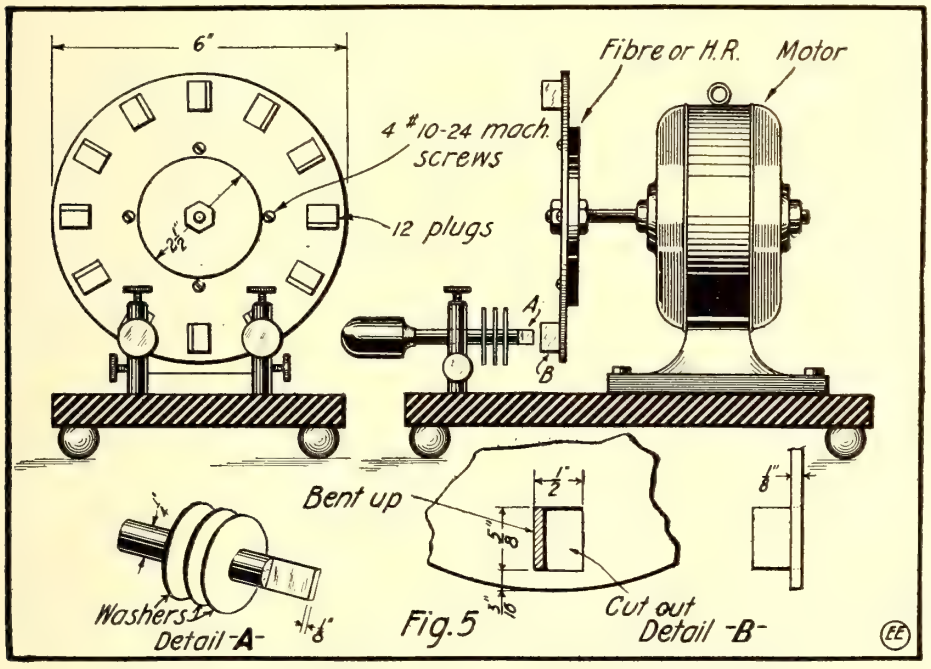


Fig. 5. Details of Rotary Spark Gap for ½-Kw. High Frequency Coil.

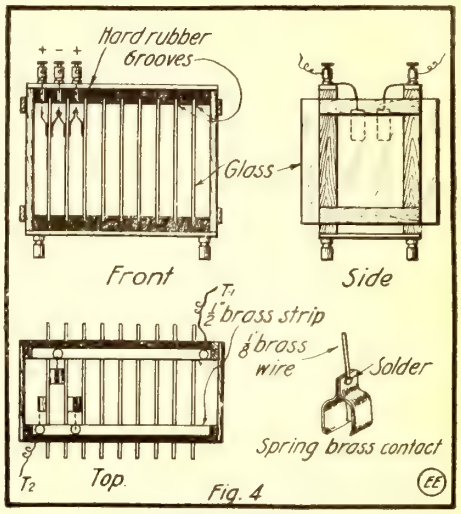


Fig. 4. Constructional Details of 12,000-Volt Glass Plate Condenser.

There is appended to this article a short bibliography of the more important articles which have appeared in *The Electrical Experimenter* on high frequency currents, and also a number of the best books available on the subject.

For those vitally interested in this subject it will be well to purchase one or more of the books mentioned. A few experiments of general interest are cited below.

An experiment not very well known, although dating from the time of Tesla's first lecture on high frequency currents, is that which demonstrates how a motor may be operated on one wire, and in some cases without any wires connected to it. Upon this and other experiments employing very powerful currents Tesla has taken out a number of patents on the *wireless transmission of energy* through space.

At Fig. 6 is depicted Tesla's scheme for a one-wire motor. One terminal of a small-size high frequency Tesla coil is hooked up to a coil of wire wound on an iron core and in front of which is placed a delicately mounted metal disc, which can rotate upon its axis as perceived. The other end of the magnet coil is connected to a metal plate suspended in the air and which picks up energy out of the ether, presumably. When the Tesla coil is excited in the usual way the high frequency current passes through the magnet coil, magnetizing the iron core, and the rotating disc starts to move. Thus we have a single

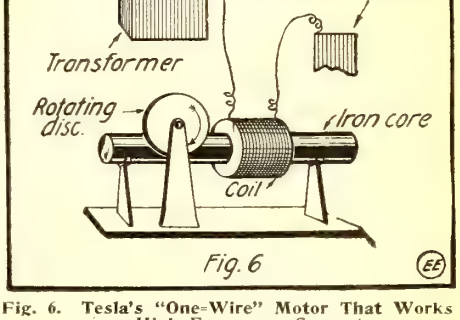


Fig. 6. Tesla's "One-Wire" Motor That Works on a High Frequency Current.

(*Continued on page 364.*)

Stepping Stones for Junior Engineers

OUR young boys and young men who are mechanically and electrically inclined have to-day wonderful facilities opened up to them in order to train their minds on elementary engineering matters. There are, for instance, books on most every conceivable subject in the engineering and allied branches of science, electric toys and other apparatus which can be purchased cheaply, etc.; but there probably never has been a more distinctly practical and self-educating device brought out for the purpose aforementioned than that involving the use of miniature steel stampings made in the form of girders, beams and other necessary accessory parts.

The illustrations herewith will give some idea of what can be done by young boys, even 10 years of age, with these miniature steel beams and accessories. There are several large companies supplying excellent outfits of this type, with which it is possible to lay out and build sky-scrapers, wireless towers, railroad steam shovels, Ferris wheels, etc., in complete replica. While the present steel pieces making up these miniature construction outfits are quite light and also low in price as regards the initial cost of same, it is hard to conceive of anything more eminently practical and instructive. It is true that, while most boys can gain considerable education by reading the numerous books available on subjects in which they may be interested, it is also equally true that to gain a thorough and practical knowledge the actual work must be done in some form or other by the student himself.

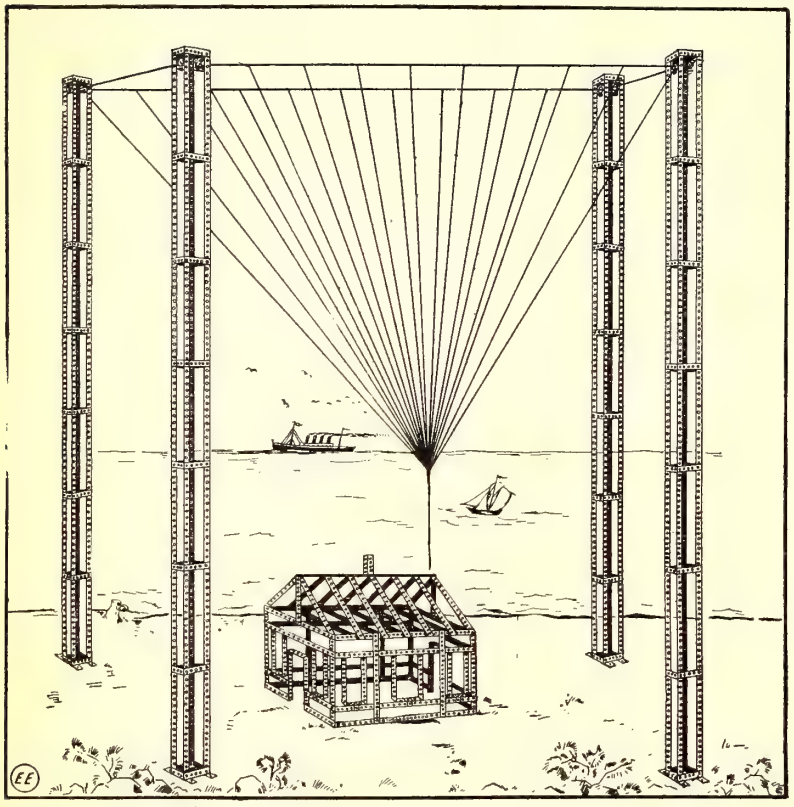


Fig. 1. Model Transatlantic Radio Station Constructed From Toy Girders.

These "stepping stones for junior engineers," as they may be called, are equally well adapted for training the mind of youthful embryo electrical, mechanical and civil engineers. At any rate, if the young student does not intend to follow up any of these professions, he will gain a practical knowledge of how building framework, towers and other miscellaneous mechanical parts are to be fastened and laid out in order to insure the greatest rigidity and strength, which knowledge all of us should have indeed.

Our illustration at Fig. 1 shows how four miniature steel masts may be constructed from these metal girders, and in this way a very good wireless aerial can be made up in replica, as perceived. Such an aerial as this would also be of good use for wireless demonstration sets utilizing the well-known coherer receptor, and particularly when these sets are used in lecture rooms and theaters where a small aerial 4 to 5 feet high or even less will suffice. The aerial may be made of copper wires No. 18 or No. 20 gauge, and a couple of insulators may be placed in the supporting towers as sketch shows. It is also possible to very easily build a miniature radio station building to be placed at the foot of the masts, as seen in sketch.

For the junior engineer there is probably nothing more interesting than the wonderful steam and electr shovels such as were used in excavating the Panama Canal, and as used throughout the country for railroad work in clearing away hills and embankments. Fig. 2 shows how one of these may be made up very nicely from these miniature steel beams. The shovel may be made to operate by an electric motor, and also a dry cell can be placed on the truck framework. If it is desired, a speed-controlling rheostat may also be mounted on the truck. To make this more complete it is well to place the whole machine on a length of track as shown in sketch. With a little skill and care this device will prove of unending interest to the boy mechanically inclined, and it will scoop up a heap of dirt in short order. The forward beam carrying the scoop proper is mounted so as to rotate, and thus each scoopful of dirt can be lifted and swung away from the truck before emptying, or it can be dumped into an empty freight car placed alongside of the shovel, thus following out railroad construction in some detail. Preferably an electric train should be used for hauling the dirt away, and in this way quite an elaborate engineering project can be carried out very nicely by one or more boys.

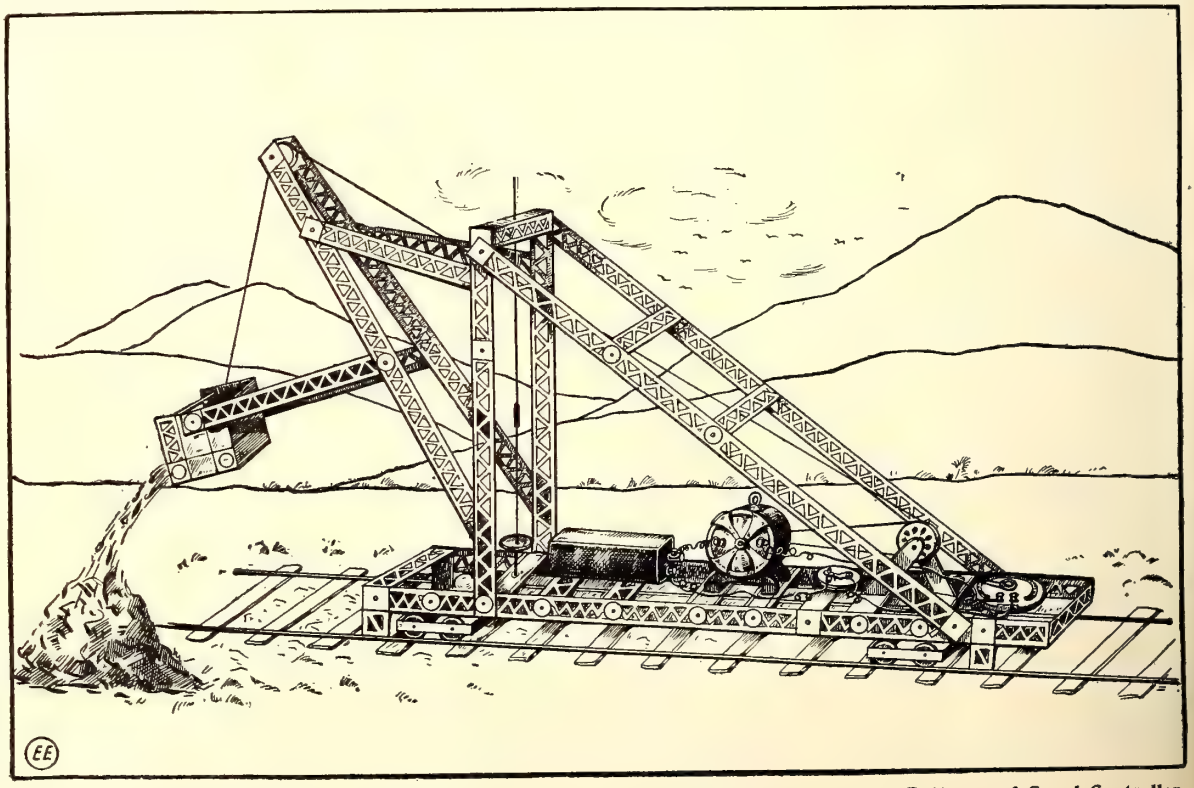


Fig. 2. A Realistic Steam-Shovel Composed of a Battery Motor, Some Miniature Girders, a Battery and Speed Controller.

At Fig. 3 is depicted details of construction for an elevator in a building, and this is moved up and down in a very natural manner by means of an electric motor, together with a rheostat, switch and battery, as observed. There is practically no limit to the number of different designs such as these which can be worked out in an excellent manner by making use of a small steam engine or electric motor and a quantity of these miniature steel beams and the variety of odd parts, such as gears, pulleys, etc., supplied with them.

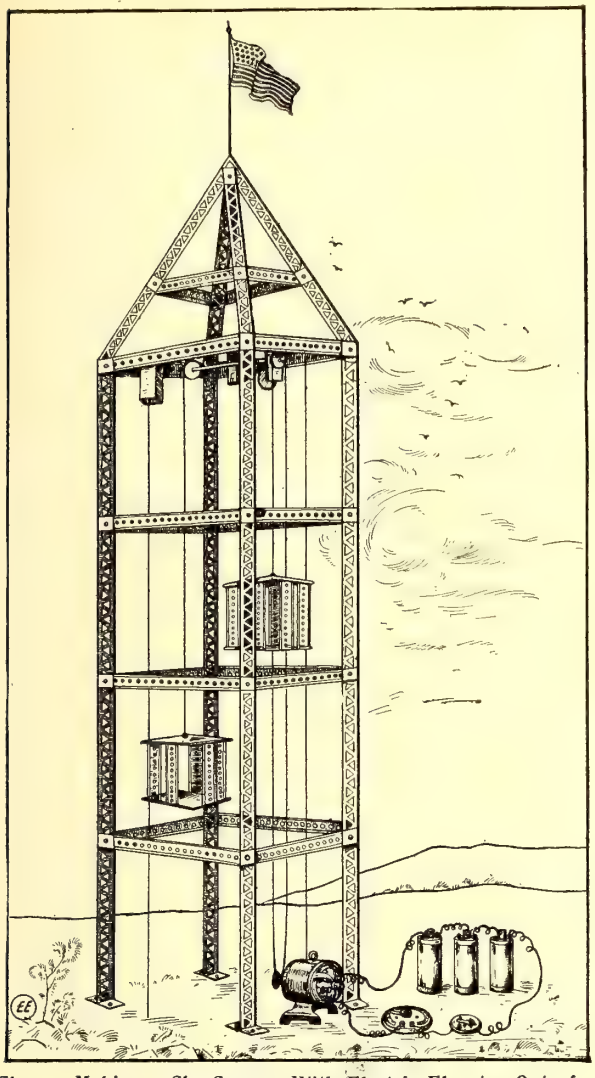


Fig. 3. Making a Sky-Scraper With Electric Elevator Out of Miniature Steel Beams.

HOW SUN SPOTS MAY BE CAUSED.

BY PROFESSOR G. W. COOPER.

As we gradually descend into a mine, toward the center of the earth, the temperature rises so rapidly that many scientists believe that the center of the earth is a molten mass, caused by pressure or gravitation. When we realize that the sun, 93,000,000 miles away, attracts the earth with sufficient force to hurl millions of tons of water on our coast line, and that gravitation decreases as the square of the distance increases we can partially realize the tremendous attraction at the center of gravity of the sun. The center of gravity, like the magnetic poles of the earth, is not stationary but is continually shifting. If electric fluid is composed of electrons, and is universal, the electrons at the center of gravity must be under a heavy pressure, and if the center of the earth becomes a molten mass under pressure, moving electrons under tremendous pressure at the center of gravity must become luminous and throw off heat.

This theory would account for the sun as a luminous body, as a source of heat, as a powerful magnet, and also for the electrical disturbances seen near the sun during a period of sun spots; and if possible under these conditions for the sun proper to have a blackened crust on its surface, holes torn through these luminous electrons by gases would account for the sun spots and the fiery streamers that are hurled thousands of miles out into space. If we wish to carry this theory further, it is possible that these same little luminous electrons will account for the rings of Saturn, the Northern Lights and our Equatorial Light.

NEW FORMULA IN CALCULATING CURRENTS.

Probably the most accurate method of determining the value of the strength of an electrical current in absolute measure is by means of the Rayleigh current balance, in which the current to be measured is passed in series through two parallel circular coils of unequal radii, one of which is suspended from the beam of a balance. The distance between the planes of the coil is varied until the force of attraction between the two coils is a maximum, and the value of the force is obtained by adding weights to the other arm of the balance until its equilibrium is restored. Since the maximum force obtainable depends on the ratio of the radii of the coils alone, and not on their individual dimensions, it is only necessary to determine further the ratio of the radii of the coils, and this may be done with great accuracy by electrical means.

The constant of the instrument—that is, the maximum force per unit current for the coils in question—has been obtained in the past by interpolation between values of the force, calculated for various assumed distances of the coils, in the neighborhood of the critical value for which the force is a maximum. For although the general formulas of Maxwell and Nagaoka give the value of the force for any two given coils, at any assumed distance, with great accuracy, no formula has been heretofore published for calculating at what distance the force becomes a maximum. To supply this lack there is derived in a paper just published by the Bureau of Standards, entitled "The Calculation of the Maximum Force Between Two Parallel, Coaxial, Circular Coils," a formula which gives the critical distance as a function of the ratio of the radii. The latter part of the paper is devoted to the development of methods for facilitating the calculations. The formulas are illustrated by numerical examples and tables, and the new formulas are shown to give results in agreement with those derived by more indirect and laborious method of interpolation.

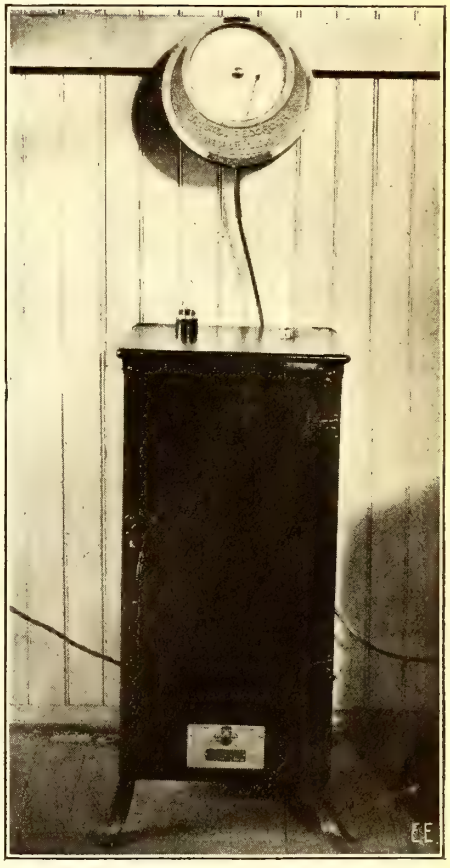
AUTOMATICALLY CONTROLLED ELECTRIC OVEN FOR TESTING SHRAPNEL.

Among the many varying applications of electricity constantly being brought before the public, and one of the most interesting at this time, in view of the conflict now raging among the leading nations of Europe, is an automatic thermostatic controlled electric oven.

This oven is for use in one of the Government arsenals in Pennsylvania for the testing of shrapnel shells. In the testing of these shells it is necessary that a temperature of 120 degrees Fahrenheit be maintained continuously for 24 hours. This control of temperature is obtained by means of a compact type of thermostat which makes and breaks the heating circuit. One contact point is carried by the expansion member of the device and the other is adjustable by means of a thumbscrew which extends outside the case. A condenser across the contact points holds the arcing down to practically nothing.

The oven is fitted with a mercurial thermometer for indicating the temperature. It is also fitted with a pilot lamp, connected in parallel with the heating element, to indicate when the current is on and off. On a continuous test for 24 hours the temperature of the oven did not vary more than one degree. This temperature reading is shown on the recording thermometer just above the oven in the accompanying illustration.

The oven is of especially rugged construction and is designed to withstand hard usage. The heating element is of the familiar type as used in electric ranges, and is rated at 200 watts.



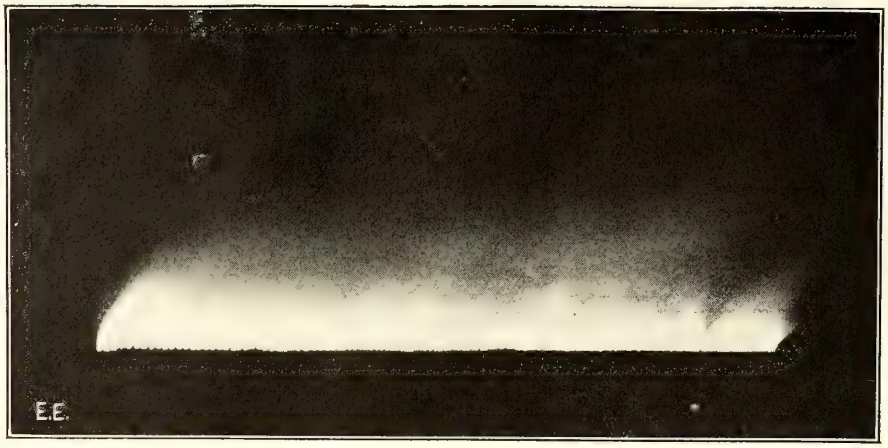
Electric Oven With Automatic Heat Control for Shrapnel Testing by U. S. Government.

Electric ovens have been found to be superior to any other method on account of the perfect heat distribution. They can be used for a number of purposes, such as enameling, baking cores, drying, etc.

ILLUMINATED STEAM CURTAIN GIVES WONDERFUL EFFECT AT AT NIGHT.

The illustration herewith shown portrays the remarkable effect produced at night by a brightly illuminated steam curtain, as erected under the supervision of a corps of Harvard University students, the work having been in charge of Theodore C. Brown, of Harvard.

This installation was employed in a wonderful outdoor show entitled "The Pageant of Lexington." This steam curtain served the same purpose as a regular theater curtain when the different scenes and tableaux were being assembled. The entire entertainment was planned on such a large scale that the only way the curtain effect could be produced, it seemed, was by the employment of a steam curtain as the photograph herewith illustrates in a vivid manner.

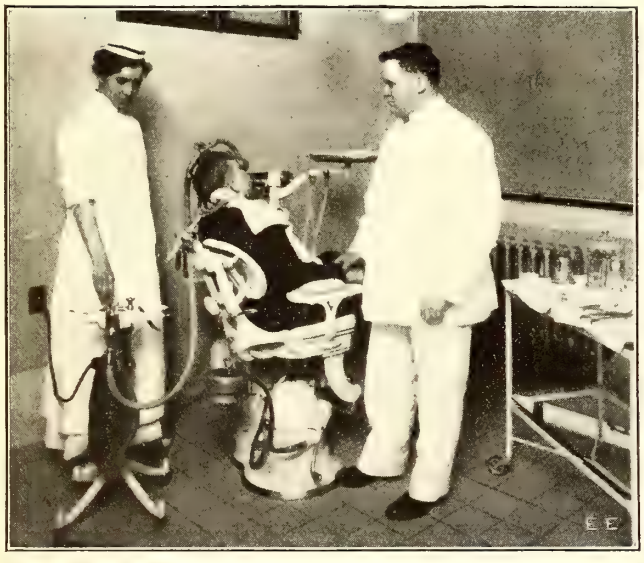


Mighty "Steam" Curtain Illuminated at Night. It Served for a Regular Theater Curtain.

The illumination for the Lexington pageant was planned by the engineers of the Edison Lamp Works of the General Electric Co., at Harrison, N. J., and it, in its entirety, involved the use of dozens of very powerful searchlights, besides a large number of powerful tungsten lamp banks and other sources of electric illumination unknown in their magnitude to the regular theater stage.

ELECTRICITY AND THE 20TH CENTURY DENTIST.

Electrical apparatus is being utilized more and more every day to aid our surgeons and particularly dental surgeons. In the photograph herewith is depicted an up-to-date electrically equipped dental operating room in a well-known hospital located in Boston, Mass. All articles in this operating room are furnished in the most sanitary way even to the chairs which are finished in porcelain and enamel.



Electricity Aids the 20th Century Dentist.

Electrical foot control rheostats are conveniently placed about the chair in which the patient sits and also an electrical respiratory device is provided while the nurse in the picture is seen operating this particular machine. This is used as an aid in the painless extraction of teeth. All drilling, cleaning and grinding of the teeth is performed by an electrically driven drill fitted with a flexible shaft enabling the dentist to hold the drill at any angle desired. Special forms of miniature "searchlights" help the operator to examine any remote part of the mouth and to work with ease and surety.

EXPLOITATION OF FINLAND'S WATERFALLS.

The Petrograd Joint Stock Company for Transmission of Water Power has made application to the Governor of Vyborg for permission to exploit the water power from the waterfalls of Rouhialasky. It is proposed to build a dam reaching from one bank to the other, with five passages of 46 feet in width for the water currents, of a depth of 58 feet. According to the calculations of the Finland Hydrographic Bureau, the flow of water is 42,000 cubic feet per second, and can be directed through four passages. The project provides for the erection of nine aggregates of turbines of 10,000 horsepower each.

Water power is the most efficient available.

EFFICIENT ELECTRIC HAMMER.

One of the special applications of electricity comes in the use of electric hammers, replacing the man with the sledge or hammer and star drill and the air compressor with its piping and hose.

The line of hammers that is made by one of the leading electrical manufacturers can be operated at a power cost that is practically negligible, ranging from two cents to five cents an hour and depending upon the size of hammer used. The equipment investment is small, only the first cost of the tool having to be considered.

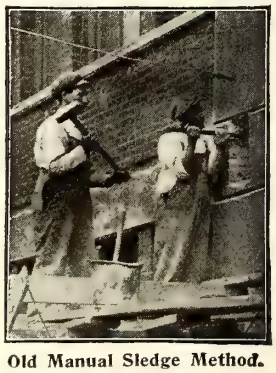
To use one of these hammers it is only necessary to connect the tool to the nearest lighting outlet or wires. The low first cost of the equipment, combined with the ease of operation, makes its use advantageous and practicable, not only where pneumatic tools have heretofore been used, but on a large class of work whose magnitude did not make it economical to install an air outfit.

A man with an electric hammer may be expected to do about as much work as six men working by hand. This is easily explained by the fact that a man with a hammer strikes from 50 to 80 blows a minute, while the electric tools strike from 1,400 to 4,000.

These electric hammers have long since passed the experimental stage and are being used successfully by companies installing switchboards, pneumatic tube systems, piping, railings, sprinkler systems, fire escapes, fire doors, etc. One large contractor tells of the great saving through the use of these tools in taking out the mortar between bricks for repointing, another of using them in breaking up old engine-bed foundations and sidewalks. Paint mills use them for dressing mill stones, ice plants and central stations for chipping scale off condenser tubes. In fact, wherever a rapid succession of blows makes for saving, these electric hammers are being used successfully. They operate on the reciprocating electromagnetic system and provide a much-desired implement for this class of work.



Improved Electric Hammer.



Old Manual Sledge Method.



New Electric Hammer Method.

THE CONSTRUCTOR



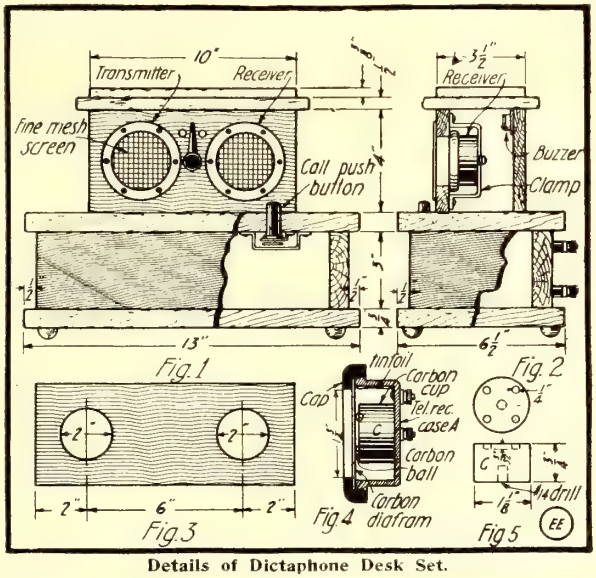
How to Build a Dictaphone Desk Set

By Homer Vanderbilt

THE desk telephone outlined below is a first-class instrument, very novel and new, besides being of easy and simple construction. Furthermore, the use of this instrument is different from the ordinary telephone, in that the receiver and transmitter are not brought into contact with the party using them. One may communicate with another party by merely placing the apparatus at a suitable distance on the desk and talk in the usual way without holding the receiver to the ear.

The case may be constructed, as shown in Fig 1, from some hard wood, such as oak, walnut or mahogany; the base of which is hollowed out, so that the ringing key and contacts may be placed inside. It should then be glued or screwed together, using flat head brass screws for the purpose, which will make a very neat job. The front wooden piece is made as depicted in Fig. 3, and into the two holes are placed the transmitter and receiver. The transmitter is of the "Dictaphone" type, as illustrated at Fig. 4. The case is built from an old watch case receiver, with the usual parts removed.

The cap is placed in a lathe and the hole made larger with a boring tool, until it measures 1¾ inches in diameter. This increases the area of the diaphragm; thereby also increasing the sensitivity of the transmitter. The carbon cup, C, is made up from a circular carbon rod 1⅛ inches in diameter and ¾ inch long. Five holes are drilled with a No. 14 drill on one face of the carbon, as Fig. 5 shows. These holes must be *exactly* drilled. The two faces of the carbon rod, C, must be exactly parallel with each other, as the operation of the transmitter is entirely based upon this point. In order to do this it is advisable to have it turned in a lathe. The bottom hole for fastening it is now drilled with a No. 14 drill, and then some melted sealing wax is poured into it. While still soft an 8-32 brass screw is inserted and the wax is then allowed to cool. This finished, it is placed in the receiver case and a carbon diaphragm placed over it, with a sheet of tin-foil pressing on the diaphragm in order to make contact. Test the circuit to see that the cup does not touch the diaphragm and if O. K. fill the holes in the cup with small carbon balls (not grains) about the size of the head of a pin, procurable from electrical supply houses. The diaphragm is now replaced and securely fastened and the tin-foil is connected to a binding post, as depicted in Fig. 4. The transmitter is now tested by connecting a telephone receiver in series with a battery.



Details of Dictaphone Desk Set.

After completion and test of the transmitter it should be placed back of one of the holes in the front wood piece and securely fastened by means of a brass strip, as Fig. 2 illustrates. The hole is then covered neatly with some coarse mesh screen.

The receiver is of the watch case pattern and also of the low resistance type. A 75-ohm receiver is obtained and the permanent and electro-magnet removed. The coil is rewound with 120 feet of No. 26 enameled wire and then replaced in the case without the permanent magnet. The connections of the coil are made in the same manner as the previous winding. After this has been done it is placed behind the second hole in the cabinet front and fastened in the same way as the transmitter. A screen is put over it, as illustrated in Fig. 1.

The ringing key, or "double contact" push button, which is located in the lower box, can be made in any form and no further description is necessary. A buzzer for calling is placed on the inside back of the case, as indicated in Fig. 2, and also a 2-point switch for the circuit is mounted on the front, as seen.

Fig. 6 outlines the connections for two sets of apparatus. Several of these outfits can be successfully used in circuit if desired. Three to four dry cells are usually sufficient for each station on 50 to 75 foot circuits.

Now, with the above apparatus completed, close the switch and press the push button. This rings the party at the other end of the line; and with both parties situated at about 6 feet from the telephones, conversation can be easily, distinctly and audibly conducted.

This new method eliminates the tiresome holding of the receiver and, above all, holding of the mouth near the unsanitary and (sometimes) germ-carrying transmitter.

As the current used is quite heavy, a large wire must be used to connect the two stations together. For stations 20 feet apart No. 18 B. & S. wire will do. For a distance of 50 feet use No. 16 wire; for a distance of 100 feet use No. 14 wire; for a distance of 200 feet use No. 12 wire.

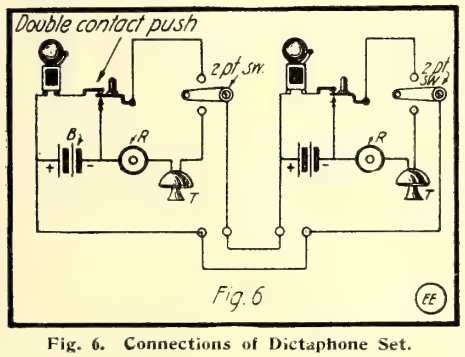
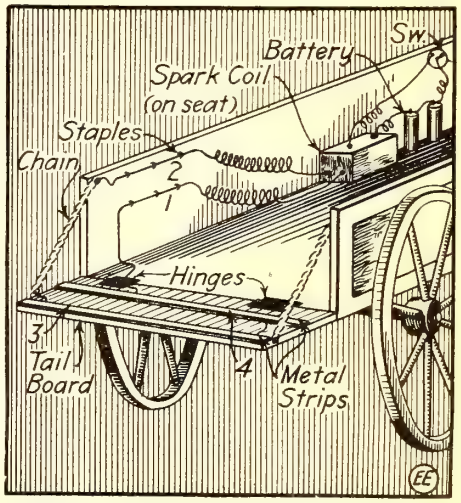


Fig. 6. Connections of Dictaphone Set.

A "KID CHASER" FOR WAGON TAIL-BOARDS.

For truck drivers and others who are often annoyed by children stealing rides on tail-boards, the following scheme will be found efficacious in the prevention of this dangerous nuisance.

All that is required is a small spark coil giving ½-inch or greater spark, together with batteries and controlling switch, which may be mounted on the back of (or under) the seat of the wagon. Two high-tension wires are carried along the frame of the wagon, as 1 and 2 indicate in sketch. One wire is joined to the hinge of the tail-board or simply direct to a metal strip 4. A second metal strip is placed across same at 3, and this is joined to the high-tension cable through the supporting chain, as sketch indicates.



Spark Coil to Keep Children Off Wagon Tail-Boards.

Now, when the youthful joy rider mounts the tail-board the driver can throw in the switch and the pleasure trip is abruptly terminated. Contributed by T. W. B.

Construction of an Inductive Tuner

By Milton B. Sleeper

Part II—(Conclusion)

Coupling Adjustment.

The back and side views of this unique control are shown in Fig. 10. On the same shaft with the handle is fastened a square brass tube. Inside this is a square rod. To prevent its interfering with the secondary taps it is bent out. The upper end, which is flat, has a round tube going through it parallel to the shaft of the handle. When the instrument is assembled a rod held

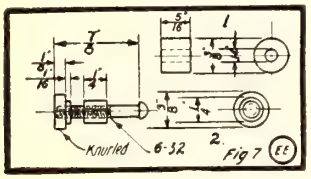


Fig. 7. Details of Binding Posts.

tightly by the screw eyes on the end of the secondary turns in the tube (see Fig. 3). As the handle is turned the square rod slides in or out of the tube, because the rod at the top must travel in a straight line, while the guides inside the primary keep the secondary from turning. Oil all the moving parts; there is no current carried in this adjustment.

Binding Posts.

Referring to Fig. 7, these binding posts are composed of four parts: a screw, a hard rubber bushing, a nut and a thumbnut. The bushings must fit tightly in the holes in the case; a little shellac will make them stick. The connections on the inside should be neatly soldered to the under side of the screw head. Then the nut is screwed tightly on the bushing. Outside connections are clamped by the knurled thumbscrews. This makes a neat and leakproof binding post.

Coil Center Pieces.

Fig. 8 gives the size of these pieces. In turning them up, bore the ½-inch hole in the center first; then turn them on a wooden face plate which has a little mandrel to fit tightly in the hole. If the hole is not exactly in the center of the pieces the secondary will not be concentric with the primary. Take (A) first. After shellacking and rubbing it down fasten it in the left-hand end of the primary tube with strong glue. To fit properly in the box the end of the tube must be at right angles with its axis.

Before fitting (B) each secondary tap must be fitted with soft rubber tubing to insulate and protect it from rubbing. When this is done pull all the taps out at the left-hand end of the coil and bind them together with string ¼ inch from the coil. Leave two or three inches of the binding string on the taps. In (B), between the slit and the center, make a small hole, just large enough to pull the loose ends of the binding string through it. Now bend the taps where they are bound and pull the ends out of the right end of the tube.

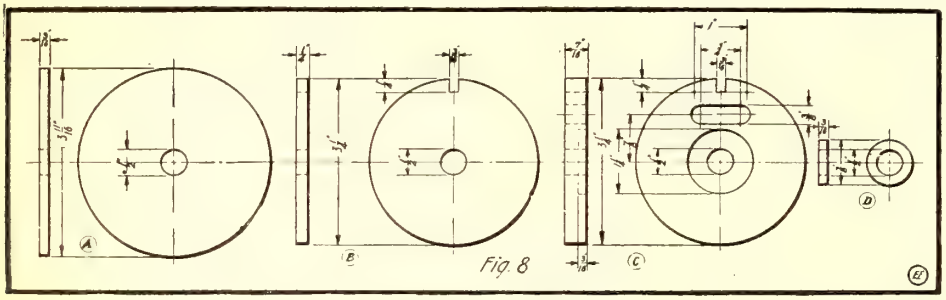


Fig. 8. End Discs of Secondary Coil.

When (B) is glued in place fasten the binding cord through the little hole, so that the taps will be held firmly to the wooden end. This is to prevent their breaking off from bending back and forth as the secondary is moved. The taps should come at the top of the coil. At the bottom of (B) fasten a little brass piece X that will slide between the guides inside the primary. Put in the piece (C). Divide the taps into three or four bundles to go through the hole in the end piece. That is all there is to do with the coils at present.

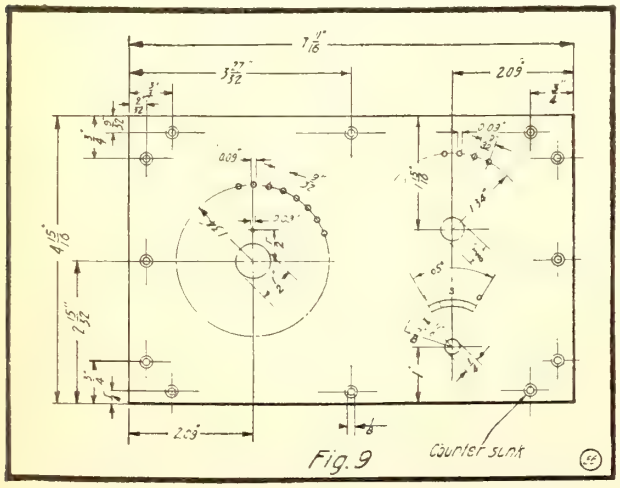


Fig. 9. Switch Lay-Out for Inductive Coupler.

Cabinet Front.

Fig. 9 gives the dimensions for the front. Great care must be used in laying out the holes for switch points. Always make a dent with a center punch first, otherwise the drill point will run over the rubber. They should be laid out with a pair of sharp-pointed dividers. First make a circle 1.34 inches in diameter. Then, by experimenting, the exact distance can be found to separate the holes. If the circle is just 1.34 inches in radius 9/32 inch will go in the circle just 30 times. The holes for wood screws are countersunk just enough to make the screw heads flush.

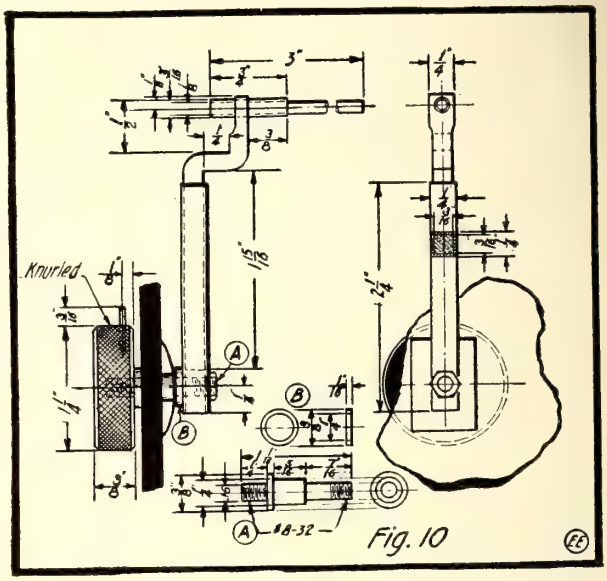


Fig. 10. Arrangement of Secondary Coupling Lever and Knob.

In laying out the scale for the coupling handle, score the hard rubber with the dividers. Then with a very fine brush fill in the scratches with white paint. This makes the scale stand out clearly.

Connecting the Taps.

When the switches are all fastened to the front it is time to connect the taps. By all means use lugs for this. The right size can be obtained from Clapp-Eastham. As each one must be soldered to the wire, it is advisable to get some very soft solder which can be melted by the heat of a match. There are several kinds on the market. Start at the left of the coil with the compensator taps, otherwise you will get into trouble. Cut off the taps a little *longer* than is necessary to reach from the coil to the switch. Do not take any chances on finding, when you put the coils in the case, that the taps are too short. Slip a piece of rubber tubing ⅜ of an inch shorter than the tap over the wires. Then solder on the lugs. It is best to try this on a separate piece of wire, for some difficulties may be encountered. When the compensator connections are made (see (2) Fig. 4) do the same to the other taps.

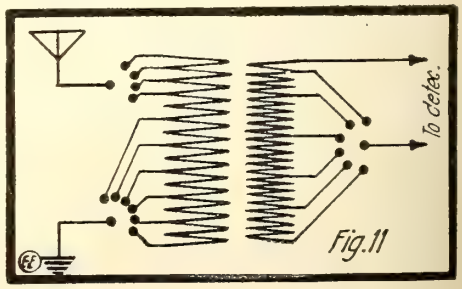


Fig. 11. Hook-Up for Coupler.

Starting with the tap from the seventh turn, fasten it to the top switch point on the large circle. Go around in order until the last one is connected to the thirteenth point. Test the coil with a buzzer and battery to see that the winding is all right. Do not touch the secondary taps until the coils are fastened in the case.

Fastening the Coils.

Now, when the case is put together, except the top (look at Figs. 2 and 3) to see where to fasten the slide tube. First put the primary, secondary and small end piece (D, Fig. 8) on the tube, with the coils in the center. Do not fasten the front on yet. Spread *cold* glue thinly on the primary end piece and the piece (D). Press them against the ends of the case, estimating the distances shown on the drawings. Quickly, before the glue can set, put two or three screws in the front—just enough to hold it in position. Take the rod which is to go through the screw eyes X on the end of the secondary and put it through the tube of the coupling adjustment (see Fig. 3). If the tube and screw eyes do not line up perfectly turn the primary or piece (D) until they are in alignment, otherwise the guide will bind against the wooden strips in the primary. Read these directions carefully before attempting to put the coils in; if you do not know just what to do beforehand you will make bad work of it. The secondary taps may now be joined. Move the secondary all the way inside the primary. Then run the taps under the long staple provided for their support, and up to the switch points. These, too, must be soldered. Do not forget, however, that the *left-hand* end goes to one of the binding posts on the right side of the case. If the taps become mixed test them with a battery and buzzer. By comparing the sounds of the buzzer the order of the taps can be determined. The copper strip from the spring of the secondary switch goes to the other binding post. The strip from the spring of the primary switch and a strip soldered to the contact of the compensator go to the binding posts at the left of the case. The compensator connection must be supported so that it will not interfere with the movement of the contact.

Fig. 11 shows the connections in the receiving circuit.

(NOTE.—The publishers shall be pleased to furnish the names of the manufacturers supplying Nos. 13, 14, 47, 60 on receipt of two-cent stamp to cover postage.—ED.)

LIST OF PARTS.

No.	Name.	Pieces.	Material.	Size.	Remarks.
1.	Front of case	1	Hard rubber.	7 11/16" x 4 15/16" x 3/16"	Polish.
2.	Back of case	1	Mahogany.	7 7/16" x 4 3/16" x 5/16"	Shellac and polish.
3.	Top of case	1	Mahogany.	7 9/16" x 5 5/16" x 5/16"	Shellac and polish.
4.	Bottom of case	1	White pine.	6 13/16" x 4 13/16" x 1/4"	Shellac.
5.	Ends of case	2	Mahogany.	4 13/16" x 4 3/16" x 5/16"	Shellac and polish.
6.	Screws for case	12	Brass.	1/16" x 1/8" diameter	Round head.
7.	Screws for front	12	Brass.	3/4" x 1/8" diameter	Flat head.
8.	Rubber feet for case	4	Rubber.		
9.	Binding-post screws	4	Brass.	7/8" long.	Round head.
10.	Binding-post nuts	4	Brass.	1/4" x 1/4" diameter	Polish with emery.
11.	Binding-post thumb-screws	4	Brass.	1/16" long, 3/8" diameter	Polish. Knurl edges.
12.	Rubber bushing for binding-posts	4	Hard rubber.	1/16" long. 3/8" diameter	Polish.
13.	Primary core.*	1	Cardboard.	3 1/16" x 3 1/16" i. d., 4" o. d.	
14.	Secondary core.*	1	Cardboard.	3 1/8" x 3 7/16" o. d., 3 1/4" i. d.	
15.	Wooden piece for primary	1	White pine.	3/16" thick x 3 1/16" diameter	Shellac.
16.	Wooden piece for secondary	1	White pine.	1/4" thick x 3 1/4" diameter	Shellac.
17.	Wooden piece for secondary	1	White pine.	7/16" thick x 3 1/4" diameter	Shellac.
18.	Tube for secondary to slide on	1	Brass.	6 1/8" long x 1/2" x o. d., 3/8" i. d.	
19.	Wooden piece to support tube	1	White pine.	5/16" thick x 7/8" diameter	Shellac.
20.	Guides to keep secondary from turning	2	White pine.	3 1/2" x 1/16" x 1/16"	
21.	Piece to slide in the guides	1	Brass.	1/2" long x 1/16" thick	
22.	Screw for above	1	Brass.	3/8"	Flat head.
23.	Screw-eyes for coupling adj	2	Brass.	1/8" eye.	
24.	Secondary switch handle	1	Hard rubber.	3/4" x 2" diameter	Polish. Knurl edge.
25.	" " centre piece	1	Brass.	1" x 1/2" diameter	Polish.
26.	" " contact	1	Brass.	3/16" x 5/16" x No. 30 B. S.	Three thicknesses.
27.	" " contact screw	1	Brass.	1/4" x 2-56 T.	Round head.
28.	" " contact plate	1	Brass.	3/32" x 1 1/8" diameter	Polish.
29.	" " spring	1	Brass.	1" x 3/4" x 1/64"	
30.	Primary switch handle	1	Hard rubber.	3/4" x 2" diameter	Polish.
31.	" " contact	1	Brass.	1 3/16" x 5/16" x No. 30 B. S.	Three thicknesses.
32.	" " contact screw	1	Brass.	1/4" x 2-56 T.	Round head.
33.	" " contact plate	1	Brass.	3/32" x 1 1/8"	Polish.
34.	Compensator handle	1	Hard rubber.	3/4" x 3/4" diameter	Polish.
35.	Compensator rod	1	Brass.	2" x 1/8" diameter	Polish. Slip in hole of No. 36.
36.	Hard rubber tube for rod	1	Hard rubber.	1 3/8" x 1/4" o. d. x 1/8" i. d.	Fit tightly in hole of No. 37.
37.	Brass centre tube for No. 30	1	Brass.	1 1/4" x 5/8" diameter	Polish.
38.	Spring for above	1	Brass.	1 x 3/4" x 1/64" thick	
39.	Compensator contacts	1	Brass.	1/8" x 5/16" x No. 30 B. S.	Three thicknesses.
40.	Compensator contact nuts	2	Brass.	1/16" thick x 6-32 T.	
41.	Compensator switch points	4	Brass.	3/16" x 8-32 T.	Round head screws.
42.	Hard rubber piece for above	1	Hard rubber.	1/4" x 1 1/2" diameter	Polish.
43.	Screw for hard rubber piece	1	Brass.	3/4" x 2-56 T.	Round head.
44.	Stopping pins for No. 42	2	Brass.	5/8" x 3/32" diameter	
45.	Switch points for primary and secondary	40	Brass.	1/4" x 1/4" diameter	Polish. Hole 3/16" deep, 2-56 T.
46.	Screws for switch points	40	Brass.	5/16" x 2-56 T.	Round head.
47.	Lugs for switch points.*	40	Copper.	Smallest size, 3/32" hole	
48.	Handle for coupling adjustment	1	Hard rubber.	1 1/4" diameter x 3/8"	Polish. Knurl edges.
49.	Pointer for handle	1	Brass.	1/2" x 1/16" diameter	Polish.
50.	Centre piece	1	Brass.	1 1/16" x 3/8" diameter	Polish.
51.	Washer for centre piece	1	Brass.	1/16" x 3/8" o. d. x 1/4" i. d.	Polish.
52.	Washer for centre piece spring	1	Brass.	1" x 5/8" x 1/64"	
53.	Square tube for centre piece	1	Brass.	2 1/4" x 1/4" sq. o. d., 3/16" sq. i. d.	Polish.
54.	Square rod for centre piece	1	Brass.	Bent. 3/16" sq.	Polish.
55.	Round tube for coupling adjustment	1	Brass.	3/4" x 3/16" o. d. x 1/8" i. d.	Polish.
56.	Round rod for coupling adjustment	1	Brass.	3" x 1/8" diameter	Polish.
57.	Nut for coupling adjustment	1	Brass.	1/8" x 8-32 T.	
58.	Primary wire	..	Copper.	No. 24 B. S.	Double silk.
59.	Secondary wire	..	Copper.	No. 26 B. S.	Double silk.
60.	Rubber tubing.*	..	Soft rubber.	1/8" i. d.	
61.	Strip for connections	..	Copper.	24" x 3/8" x .005"	
62.	Support for secondary taps	1	Brass.	Bent. 1/64" diameter	

* Means, see end of article.

HINTS TO THE AMATEUR.

It is indeed surprising what a wealth of electrical material for the experimenter may be found around telephone exchanges, local electric shops and garages. Material such as porcelain parts, magnets, wire, slightly used dry batteries and many others, which will delight the experimenter with a somewhat flattened pocketbook, may often be obtained for the asking.

In one instance a wireless amateur received a complete head set and enough wire for an aerial in this way, while I have used with success for six months, on my 1-inch spark-coil set, dry batteries which were discarded from an automobile. A No. 8 B. & S. covered line wire, which had been thrown away at a power house, was utilized for making a dandy helix. The insulation was removed by hammering on it, causing it to separate from the wire, or it could be burned off.

The center binding posts of "Columbia" dry cells may be used for taps on a loose coupler, after being cleaned by placing in a diluted solution of sulphuric acid and then filing the heads quite flat.

The cup on the center of the "Ever-ready" type of dry cells may be used on a detector for holding the crystals, while the wax on the top of dry batteries may be remelted and cast in paper molds to make a variety of knobs.

Enough magnet wire for a loose coupler may be secured by asking for a burned-out "telephone bell" *with magnets,* at a local telephone office. A friend of mine secured, gratis, an old automobile ignition spark coil at a garage, and has used it for sending message one-half mile nicely. Contributed by WM. R. COTTRELL.

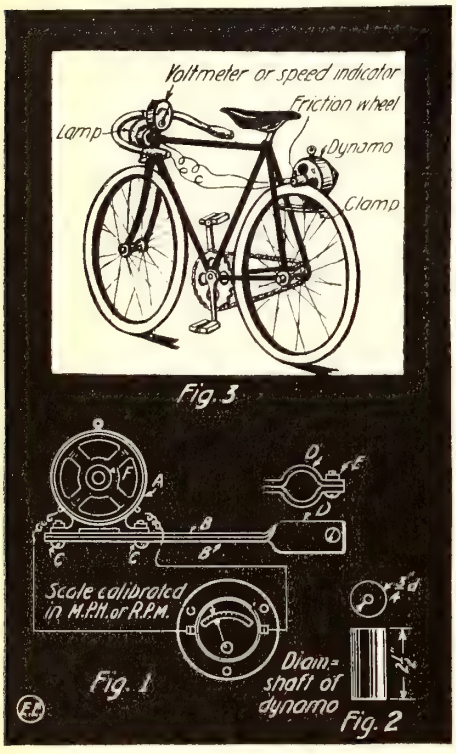
GERMANTOWN RADIO ASSOCIATION.

The Germantown Radio Association, of Philadelphia, Pa., would like to receive a few "sparks" from those interested in radio work. The club is now located at 5801 Germantown avenue, Germantown, Philadelphia, Pa., and meets on the third Monday of each month.

HOW TO BUILD AN ELECTRIC SPEEDOMETER.

A most interesting application of electricity is represented in an electric speedometer, an instrument used for denoting the speed of vehicles or any other moving object.

This type of speedometer consists essentially of two parts, viz., a direct-current generator of low amperage, which is driven



Electric Speedometer for Bicycles.

by friction or gearing from the wheel of a vehicle, for instance, and a voltmeter connected directly to the generator.

The dynamo, Fig. 1, may be an 8 or 10 volt machine. Now make the supporting parts, which consist of two iron clamps B B, attachable to the dynamo frame by means of bolts C C. The curved part D is used to fasten the dynamo to the vehicle, such as a bicycle frame, tightened by another stove bolt E. Any other suitable means can be employed in fastening the dynamo.

A small rubber friction wheel is next made, and it is shown in Fig. 2, no explanation being necessary, as all the required data is given. It is driven tightly on the dynamo shaft and is to be placed in contact with the driver wheel.

The recording device consists of an ordinary voltmeter, but another scale is substituted for the original one and calibrated in speed units, such as "miles per hour" or R.P.M., etc. The method of calibrating the voltmeter is as follows: Obtain a standard speedometer and place on the driver wheel, and at the same time secure the dynamo near the same driver and connect it to the voltmeter. Now start the vehicle wheel running (on a frame) and observe the scale on the standard speedometer, and note the position of the voltmeter needle. At that point mark a line, and the same figure as the standard speedometer is showing. Various points should be thus checked off in the same manner by running the vehicle wheel slower or faster.

This device can be used as a tachometer or revolution per minute indicator, the one point that must be remembered being to use a standard R.P.M. indicator as a means of calibrating.

The voltmeter should be placed in a convenient place, so that the operator may cast his eyes on it very quickly. On a bicycle a good place is on the handle bars, as shown in Fig. 3.

This speedometer can also be used on automobiles, carriages, motorcycles and any other form of vehicle. It is useful indeed for testing machinery of all kinds. The calibration can be performed by calculation, aided by a common hand speed indicator. A small telephone magneto serves very well for this stunt, but then the voltmeter must be an A. C. instrument. Contributed by

SIDNEY SISSELMAN.

AN ELECTRIC KEY HOLE FINDER.

For those gentlemen who are inclined to stay out too late in the evening, or rather *morning*, and who often experience considerable trouble in locating the keyhole in the front door of their domicile, the following wrinkle may be of interest:

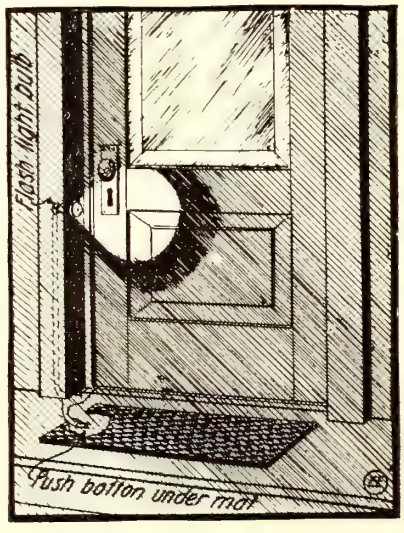
I notched out a small hole in the side of the door frame on my front door and placed in it a miniature battery lamp receptacle and a small Tungsten flashlight bulb. A battery may be placed in the cellar similar to a bell battery, etc., and ordinary bell wires, preferably fished up inside of the door frame, or otherwise neatly concealed, lead from the lamp socket to a circuit closer placed under the front door mat as the sketch shows. This circuit closer may be purchased at any electrical supply store and can be located under a certain corner of the mat, etc., so that the home-comer will possibly sooner or later place his foot on the proper part of the mat, and thus flash on the lamp which illuminates the keyhole.

It is hoped that this novel idea will be found welcome to many brother "Elks." Some nifty stunt. Eh! what?

Contributed by

ALBERT GALLAGHER.

It is generally admitted that the hardest problem is to find the keyhole in the "wee small hours" of the morning. The writer of this article presumes, evidently, that the rapidly oscillating movement of the feet



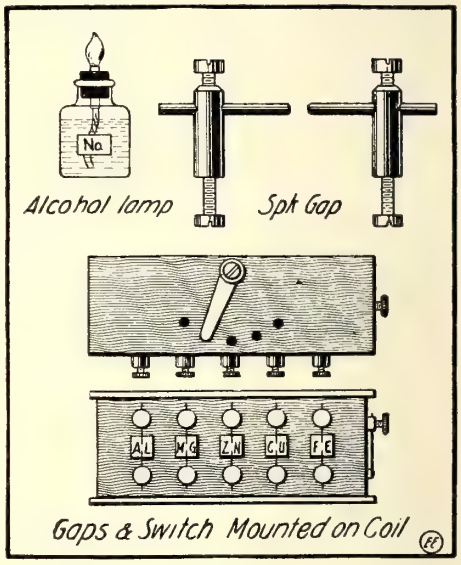
An Electric Light Finds the Key-Hole For You.

very shortly will locate the proper contact spot on the mat.—Ed.

CHARACTERISTIC FLAME COLORS OF METALS.

When a gas containing metallic ions is heated to incandescence it exhibits a color and a spectrum which are characteristic of the metal which it contains. Each of the 60 or 70 known metals has its own *flame color* and *spectrum*. With the alkali and alkaline-earth metals, it is only necessary to heat a salt of the metal in order to obtain the colored flame. With all the others, however, the metal itself must be volatilized, which can readily be performed by the electric arc or spark.

The exhibition of these various flame colors is an interesting and rather spectacular experiment. For the metals of the first division the apparatus is very simple. An alcohol lamp, which can be easily made out of a small bottle, a cork, a metal tube and a wick, is provided for each metal and labeled. In the alcohol of this lamp a salt



Apparatus for Testing Flame Colors of Different Metals.

of the desired metal is dissolved. The chloride is the most convenient, both because it is the commonest salt and also because it is soluble in alcohol. The salt must be chemically pure, for if it is not it is sure to contain traces of sodium, whose brilliant yellow flame quite obscures that of any other metal.

The presence of traces of sodium in atmospheric dust and moisture may be proved by holding almost any object (an iron nail for instance) in the colorless Bunsen flame, which will be turned yellow for a moment. If the salt dissolved in the alcohol is chemically pure, however, the flame of the alcohol lamp, instead of being colorless, will be yellow, violet, green, orange or deep crimson, according to the metal used. In a darkened room this is very striking. The colored flame, when examined with a spectroscope, shows the characteristic lines of the metal.

For showing the metals of the second class a series of small spark gaps are used; the electrodes of the different gaps being made of the metals to be examined. The gaps are put into operation, one at a time, by means of a suitable H. T. multi-point switch. The electrodes should be very close together, almost touching, so that the "spark-ball" may be formed. A very brilliant flame is produced in this way. It may be examined with a spectroscope, the same as the alcohol flame.

Below is a list of the more common metals and their flame colors:

FIRST GROUP.

Sodium, Na	Yellow
Potasium, K	Violet
Calcium, Ca	Orange
Barium, Ba	Green
Strontium, Sr	Crimson

SECOND GROUP.

Magnesium Mg, Aluminum, Al.	Dazzling white
Zinc, Zn	Blue
Copper, Cu	Green
Iron, Fe	Reddish yellow

Contributed by B. MACKEY.



The Amateur Radio Station Which Aided Uncle Sam

A Complete Description of the Wireless Station of Mr. Charles E. Apgar—Full Details of the Audion Amplifier Circuit and the Inductance Coils Are Here Given

By Charles E. Apgar

SINCE the publication of the article on recording Sayville radio signals phonographically in the September, 1915, issue of the *Electrical Experimenter*, so many inquiries have been received by me from interested amateurs and others concerning many details of construction, circuits, etc., that I thought that possibly a more complete statement concerning the station and the work accomplished would be welcomed by many readers. Also since the station has been so generously referred to in the daily and technical press since July 18, 1915, a brief history of the station itself will surely be of interest.



Fig. 1. Top View Depicts Mr. Chas. E. Apgar Receiving Wireless Messages at His Wonderfully Efficient Experimental Radio Station Located at Westfield, N. J.



Lower Photo Shows Mr. Apgar in the Act of Actually Recording a Long Distance Radio Message on a Phonograph Cylinder. This "Canned Wireless" Has Helped Uncle Sam Immeasurably.

Not many years ago, less than five, when looking over a magazine in a stationery store on Broadway, New York, I noted in the back section some zig-zag lines and drawings (diagrams of radio circuits). The magazine was immediately laid aside with the thought: "What nonsense to print such crazy stuff which only an expert can understand."

About a month later the New York Herald published a letter signed "Amateur" stating that on the previous evening (Election night, November, 1910), he had copied the Herald's wireless Election returns and knew the results of same before 11 p. m. of that evening. Comments by the editor followed, stating that "Amateur" was a cashier in one of Wall Street's well-known banking houses; the name and address were also given. This was my first stopping place when again reaching the city.

This cashier soon discovered that I didn't know a tuning coil from a detector, so he gave me a copy of the latest catalogue of one of the leading experimental wireless supply houses. Careful study of this and recalling the zig-zag lines and drawings in the magazine (Modern Electrics), to which recourse was made, gave me sufficient insight as to the requirements of amateur wireless telegraphy to make a "try-out" about one month later (Dec. 11, 1910). I shall never forget with what satisfaction I made my final connection on that memorable evening. In less than one minute I heard O. H. X (now W. H. B.) Seagate and one other station. Contrasting this with the experience of some amateurs (who, as I have read, often spend a month or more fooling around before getting a single signal), to say I was satisfied is putting it mildly. Of course, the whole family was called in—even the cat—whose "meow" was about as near to a wireless signal as anything I had ever heard.

Having caught the fever and having some constructional ability, my instruments were home-made, excepting the detector stand and silicon (purchased from the E. I. Co.) and 'phones. After installing this set on a suitable operating table and getting reasonably familiar with tuning operations, even to picking up Cape Cod (old M. C. C., distant about 250 miles), I decided to look into the matter of sending signals. I found a single unit automobile spark coil among some electrical junk, connected this to my aerial through some wire wound around a box and having no sending key, tapped on one of the binding posts with one of the battery wires to see if it would buzz. It did. Then without knowing why, I tapped off the call "B. Q.," whom I had heard sending to other amateurs. "B. Q." lived many blocks away, but after a reasonable time the door bell rang and, much to my surprise, there was B. Q. in person. Said he had heard me call him, and though it was near midnight, came around to see what I wanted. This experience led me to believe that an efficient sending set would not be difficult to make. I soon began constructing a ½ K. W. open-core transformer, also a suitable condenser, using aluminum sheets and old photographic plates; an ordinary spark gap at first, but later a rotary, capable of breaking 960 per second. Getting rather tired of hearing "How's my spark?" "Do I sound better now?" I decided to turn my attention to improving my receiving apparatus. In all seven different tuning coils and loose couplers, each possessing some special feature, have been made (see Modern Electrics, January, 1914). Variable rotary condensers were next constructed and, being dissatisfied with the unstableness of crystal detectors, I decided to try out an audion during August, 1913. Having some knowledge of the effects of magnetism on electricity in a vacuum, I placed a magnet near the audion, when instantly the signals seemed about ten times louder. Here was a discovery—to me at least. A new 150-foot steel mast loomed up, as well as other extravagant expenditures—all to come from the proceeds of this discovery—but a short time spent in the city library brought me to earth again. I still have my aerial in the trees.

The use of the magnet was continued for some months with gratifying results. Many stations, with the use of a small horn on the receiver, could be read about 50 feet from the 'phones. Having been able so definitely and satisfactorily to produce loud incoming signals, the matter of amplification occurred to me. I tried out various types of microphone transmitters. Best results, though far from satisfactory, were obtained by a certain form of carbon transmitter, using a low voltage current. Signals from many stations, when using this circuit after some modifications and giving careful consideration to sound resonance, could be plainly heard and read all over the house.

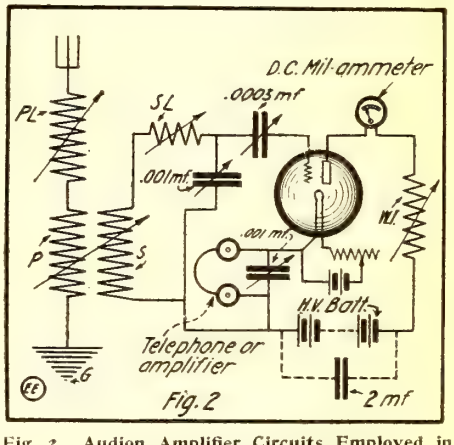


Fig. 2. Audion Amplifier Circuits Employed in Mr. Apgar's Radio Station.

Naturally the matter of making permanent records occurred to me about this time. I bought a second-hand phonograph, and on Oct. 28, 1913, made my *first record*

of wireless; this being "press," sent out by the New York Herald station at the Battery in New York. Following this and until about October, 1914, many records were made of N. A. A., N. A. H., W. C. G. and other stations. By the adoption of the audion circuit discovered by Mr. E. H. Armstrong, the receiving efficiency of my outfit was enormously increased, as well as being enabled to bring in many undamped wave stations, including W. S. L., W. G. G., N. A. A., N. B. A. and others. Interesting phonograph records of several of these undamped stations have been made.

The photograph of my station is shown in Fig. 1, which consists virtually of a loose coupler, primary and secondary loading coils and three variable condensers connected to an Armstrong circuit as perceived in Fig. 2. The dimensions of my inductance coils are as follows: Primary of coupler is 10x5 inches and is wound with No. 22 S. S.; the secondary is 10x4¼ inches, wound with No. 28 S. S.; the secondary loading coil SL is 22x3½ inches and wound with No. 30 S. S., while the wing inductance WI has No. 30 S. S. for its winding. The capacity of each condenser is given in the diagram.

A direct current milli-ampere meter is connected in series with the grid circuit as shown and signals* can actually be read by observing the movement of the needle. An amplifier of my own invention is connected in place of the regular 'phones and a low resistance receiver with horn is coupled to the amplifier. The same 'phone can be placed over the recorder of a phonograph and thereby messages may be copied on a record. Fig. 3 illustrates the phonograph which has recorded all the Sayville "secret code" messages—note the telephone receiver on the reproducer.

My aerial is 600 feet long, the wires starting 10 feet apart and ending 18 inches apart (fan shaped); the average height is about 50 feet. With this set I am able to tune to 4,000 meters without any aerial inductance coils, and if loading coils are connected in the circuit I am able to receive stations of over 9,000 meters wave length.

While the September, 1915, issue of this magazine has given rather a full account of the work done at the request of Chief W. J. Flynn, of the U. S. Government Secret Service Bureau, probably the addition of a few other details will make the account more complete.

A short time before being asked to do this work a business call was made on Chief Radio Inspector W. P. Krumm at New York City, and during a conversation on amateur plants in general he expressed a desire to visit my station. During this visit, which soon followed, the general efficiency of the station was demonstrated, also many phonographic records of wireless signals were reproduced. Hence when Chief Flynn consulted W. P. Krumm about the *checking up of Sayville* I was called in on the matter and told to "get busy." The work of making the records began each night at 11 o'clock and continued for two or three hours, dependent on the accumulation of messages at the Sayville station. The next morning a translation of the records was made and a copy of them turned over to Chief Flynn, which permitted of immediate comparison with the censored message records received by other departments of the Government. Later on all the phonograph records made were delivered to the Secret Service Bureau at New York City.

* One of our editorial staff has recently witnessed this experiment with the milliampere meter. Signals were reabable by merely observing the needle. One of the greatest feats ever produced by any amateur is receiving N. A. A. 600 feet from the 'phones, which is an actual result accomplished by Mr. Apgar. He has received the "time signals" from Arlington in the open street, full of shade trees and while noises of all kinds were in the vicinity. Of course, if these conditions did not prevail the signals would undoubtedly be heard at a much greater distance.—EDITOR.

New Pocket Wireless Set

One of the latest developments in the wireless field is a small, pocket-size wireless instrument which can be used for transmitting or receiving such messages over distances of one-quarter to one-half mile and more. This particular apparatus as shown in our illustrations has been perfected by Dr. H. Barringer Cox, of New Bedford, N. Y. The inventor himself is seen in our illustrations, the one at the right depicting Dr. Cox in the act of receiving a wireless message by means of the apparatus strapped about his waist as perceived, and the antenna consists of a hollow tube held in the hand.

The left-hand view discloses how the apparatus may be worn under the coat, and it is held in place by a belt, as becomes evident. The 'phone and head-band can be hooked in the belt very readily, and it is suggested by Dr. Cox that this outfit would undoubtedly prove of great value for the soldiers in the field. He intends to loan his invention to the European armies now at war. Such an outfit as this can be worked over such distances as aforementioned and should prove of extreme value to the men in the trenches or on the open field for transmitting and receiving orders, etc., as the enemy would not very easily take notice of such a well-concealed wireless instrument as this, even though the operator was in sight. The apparatus comprises an especially sensitive detector, together with the usual high resistance head 'phone and a tuning coil with condenser. A flexible wire joins the watch-case telephone receiver to the tuning coil case, and another flexible conductor joins the hollow metal tube held in the hand to the instrument proper. In some cases the tube has been placed in the ground and messages received and transmitted in this way. When the metal tube is held in the hand, as shown in the right-hand photograph, it would undoubtedly be best to make a ground connection by means of a wire connected up with a metal plate on the bottom of the shoe.

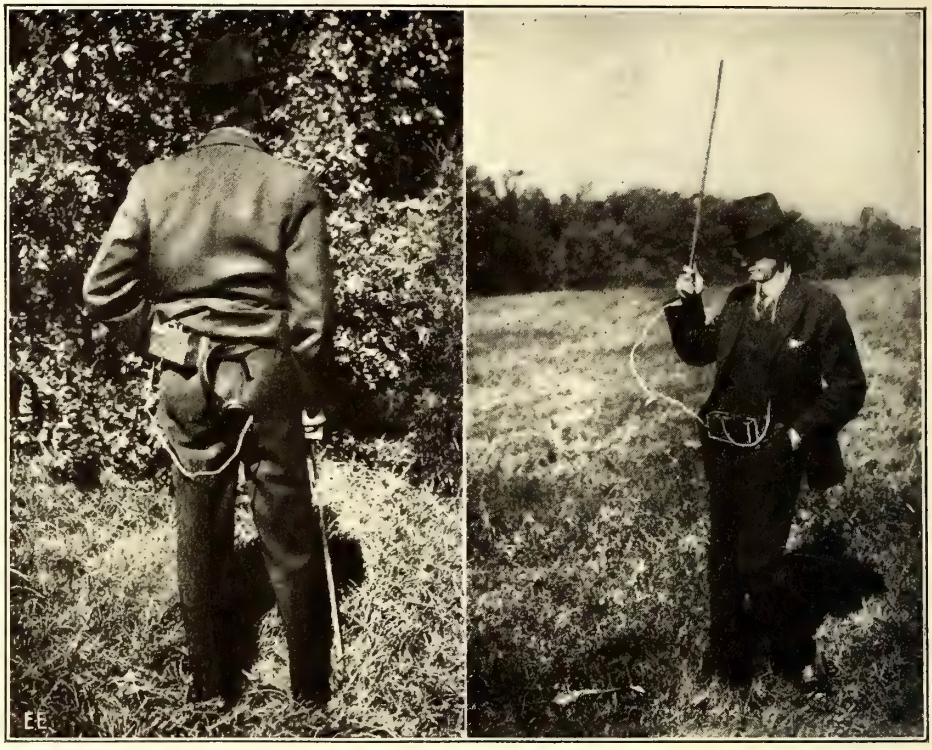


Photo (C) by Underwood & Underwood.

At Right: Dr. Cox Receiving Radio Signals With Pocket Set.
At Left: Showing New Pocket Wireless Set Fastened to Belt.

MARCONI ABSORBS ENGLISH POULSEN INTERESTS.

A syndicate representing Marconi interests has acquired the Poulsen-Padna rights, and in due course the Poulsen system will become part of the Marconi organization.

According to this report, an important option in connection with the British Poulsen wireless rights lapsed recently, though fresh arrangements would quite possibly have been made. In the meanwhile, however, the syndicate representing the Marconi interests, recognizing no doubt what a formidable rival the Poulsen system would be in the future if it remained independent, has stepped in and made an offer which apparently has been accepted.

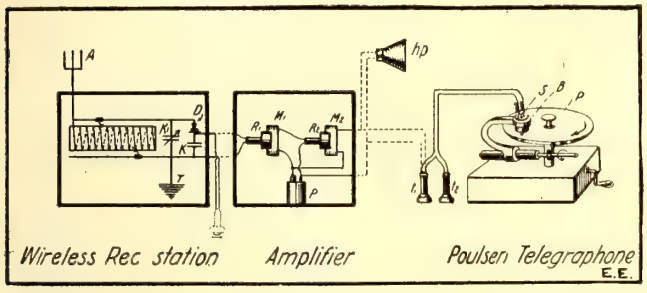
For the present, owing to Treasury restrictions, formation of a subsidiary company and other financial arrangements for the completion of the deal cannot be put through, but after the conclusion of peace it may be looked upon as certain that Poulsen will be under the Marconi banner.

The Poulsen system of wireless telegraphy, worked out by Valdemar Poulsen, of Copenhagen, eight years ago, is said to be a much faster means of communication than that of Marconi. In 1907 Professor Poulsen also talked by wireless between Copenhagen and Berlin, some 250 miles, and proposed to establish a wireless telephone service to America, via Ireland. The Poulsen patents in the United States are controlled by the Federal Telegraph Co., of San Francisco, Cal.

A MACHINE THAT CAPTURES AND HOLDS WIRELESS TALK.

When one contemplates the marvel of sculptured sound on a graphophonic record, and realizes that from the cold vorticity of line there may magically spring the golden lilt of the greatest song voice that the world has ever heard, then comes the conviction that we are living in the days of white magic.

This is simply by way of introduction of a greater marvel yet—a marvel of marvels, so to speak, regarding the reproduction of sound. It is the application of the Poulsen



System for Recording Wireless Telegraph Signals on Telegraphone.

telegraphone to the writing and the recording of wireless messages. And as the voice is now being sent over considerable distances by way of the ether, it has to do. in its logical extension, with the human voice.

Contradictory as it may seem, this new method of writing and recording wireless communication uses recordless records—that is, they cannot be seen and read by any of science's aids to the eyes. A wire is the only thing an observer may see.

The Poulsen invention, you may probably know, is a magnetic phonograph which records sound vibrations, not by actual needle marking on a plastic disc, but by variations of magnetism in a steel disc. You can note the concentric lines made by the needle on a familiar musical record, but the steel wire used by Poulsen looks precisely the same after a song or a sentence has been stored up in it.

Imagine a dead piece of metal, with no visual indication of how it is accomplished, holding human speech imprisoned in its cold confines and music and sound vital to the progress and enlightenment of the world!

THE VOICE IS STORED IN MOLECULES OF METAL. And here is a baffling mystery in this storage. Precisely what the nature of it is man shall not know, we are told by authority, until the mystery of magnetism is fully solved.

The wizard responsible for the new and wonderful discovery is named Dosne, and Lucien Fournier, in describing his achievement, naturally speaks first of Poulsen's earliest model. It was then constituted by a bobbin of steel wire which was made to turn under a receiving coil. The wire records speech magnetically and it is reproduced in a telephone receiver when the coil that has been influenced passes a second time under this receiver.

The device used by Mr. Dosne differs from this early model by replacing the steel wire with a steel disc turning under a light soft-iron needle forming part of the electro-magnetic receiver of the apparatus.

This apparatus moves from the edge to the center of the disc during the inscription, so that the record is spiral, like that on a graphophone disc.

The Poulsen device cannot be used for recording wireless signals; the coil connected with the needle planned for use as a telephone record needs modification for adaptation to the new kind of work required of it. Mr. Dosne has taken account of this necessity, and has conceived the ingenious idea of powdering the steel disc with a finely divided magnetic substance—iron reduced by means of hydrogen—in the hope that this powder would collect along the magnetized traces left by the soft-iron stylus.

In these conditions, although at first the reinforcement appeared scarcely sensible, it was possible to prove that it existed, in a very original manner, at the wireless laboratory of the Eiffel Tower station at Paris. During the experiment signals from Cleethorpe and from Clifden were heard, but the disc recorded only the first, which were the loudest. But, after the employment of the powdered iron the Clifden signals were recorded.

Our diagram shows Mr. Dosne's plant. It includes a wireless receiver with a crystal detector; the telephone has been removed and replaced by an amplifier. Finally the Poulsen telegraphone is connected, in the place of the loud-speaking telephone, to the amplifier.

In these conditions it suffices, to record a message received at an ordinary wireless station, to start the steel disc rotating in order that the fluctuations of the current, passing through the combined telephones and miscrophones of the amplifier, may determine in the coil of the Poulsen apparatus a variable magnetic field, of which the little soft-iron needle constituting the core of the coil forms a part.

The message is read by placing the ear at one of the telephones of the Poulsen apparatus, which, after the registration, behave like simple receivers and repeat the message.

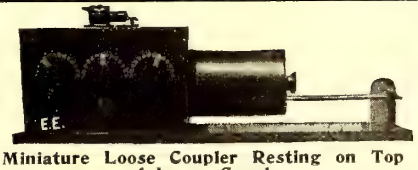
It should be noted that the speed of recording a message may be modified for repetition. In fact, the disc may be made to turn at a greatly reduced speed if one is not well trained in sound-reading; but in this case the signals lose in intensity. On the other hand, if the speed of reception is greater than that of record, the signals gain in power.

The same disc may serve indefinitely if it is not desired to preserve the record.

(A) Antenna. (D) Crystal Detector. (T) Earth. (K) Fixed Condenser. (K1) Adjustable Condenser. (R1) Prime Receiver. (M1) Its Microphone. (R2) Secondary Receiver. (M2) Its Microphone. (P) Steel Plate. (B) Poulsen Coil. (S) Soft-steel Needle. (t1-t2) Receiving Telephones.

THE SMALLEST LOOSE COUPLER.

What is probably the smallest loose coupler ever built and suitable for actually receiving wireless signals is shown in the photograph. It is perceived resting on top



Miniature Loose Coupler Resting on Top of Large Coupler.

of the large coupler, which latter measures about 2 feet in length. The large coupler is fitted with three primary switches, and same is capable of tuning in wave lengths up to 9,000 meters when used with a fair-size aerial. The miniature loose coupler resting on top of the larger instrument is so small that it will fit in the hand nicely without projecting beyond the fingers. It is complete in every way, being fitted with a primary tuning slider as well as with a six-point switch on the movable secondary, accurately wound with comparatively fine magnet wire. This small coupler has been used a number of times and operates very efficiently in bringing in wireless signals. It is capable of tuning in wave lengths up to about 200 meters when used with a small-size antenna.

CONCERNING GROUND ANTENNAE.

It may be interesting for the amateur radio readers of your magazine to know what success I am having using a ground antenna.

I laid two stretches of No. 18 insulated bell wire directly on the surface of the ground in my back yard (in Boston), the length of each stretch being about 25 feet. The lead-in was taken from the middle, thus forming the shape of a "T." The instruments I use are a single-slide home-made tuner, galena detector, 75-ohm telephone receiver and an E. I. Co. loading coil. With this aerial I receive the Boston Navy Yard and a number of stations around the harbor. I had some correspondence with an experimental radio station here regarding this "ground antenna," and they advised me that this type of aerial has a directional effect; that is, if it runs due north and south, stations east and west cannot be heard. I advised them that my aerial runs directly sideways to the Boston Navy Yard and I receive messages right along from this station. They wrote and told me that my not encountering directional effect with this ground antenna is due to one of two things—either the wires are so far short of the proper length that I get forced oscillations, or else there are local electric wires that neutralize the actual direction of my wires. I shall be pleased to hear from any amateur who experiments with this type of aerial. Contributed by P. J. LEARY.

NEW ORLEANS RADIO OPERATORS MAKE FINE RECORD.

Complete success greeted the recent initial attempt of the radio operators at the New Orleans Naval Station to flash a message to the Government wireless station at Darien, C. Z.

The test message was sent at 10 o'clock in the morning, and Chief Operator McKean, of the local naval station, had no difficulty in communicating with the men in charge of the station on the Canal Zone. The distance between here and Darien is approximately 1,600 miles, and the operator on the Canal Zone stated that the signals from New Orleans were so strong as to almost affect the ear drums.

The sending of the long-distance message to the Panama Canal by the New Orleans Naval Station marked an epoch in Government radio circles. It means that the final link in a chain of wireless stations to connect the United States and points in the tropics, as well as our possessions in the Pacific, has been completed.

Two 300-foot steel towers and an exceptionally powerful set contribute in making the New Orleans radio station one of the best yet completed. A force of 16 operators will be required in handling the radio equipment when the station has been brought up to its full strength, it is said. Most of the dispatches flashed through the air from the ships in Mexican and other tropical waters are expected to be handled directly through New Orleans.

HOW WIRELESS WAVES TRAVEL AROUND THE EARTH'S CURVATURE.

MOST people probably do not stop to consider what a great depth of earth exists between two modern long distance radio-telegraphic stations



Fig. 1. Illustrating the Vast Depth of Earth Between Two Transatlantic Radio Stations.

when they are in communication with each other as, for instance, is the case between Sayville, L. I., U. S. A., and Nauen, Germany, located near Berlin. The approximate distance between these two modern high powered wireless stations is 4,000 miles and, as Fig. 1 shows, the curvature of earth lying between these two stations has a chord height of 348 miles. At either station the lofty steel towers supporting the aerial wires, from which the waves are liberated or sent out, only have a height of from 600 to 800 feet in any case. This, of course, is a very, very small percentage of the depth of the earth's curvature intervening between the two stations, as will be perceived.

Several theories have been brought forth from time to time in the progress of the radio art as to the probable method by which such long distance wireless telegraphic signals are *propagated around* one-fifth and even one-quarter or more of the earth's circumference. Many scientists claim that the waves glide over the surface of the earth, as shown in Fig. 2 at A A A. This is based on the consideration that the earth's surface acts as a charged conductor and thus serves to guide the waves, so to speak, in their path between the stations. Of course, the waves radiate, practically speaking, equally in all directions from a given point (as about an aerial) in the form of a circle. Only the half loops are supposed to glide over the surface of the earth, as Fig. 2 indicates; the

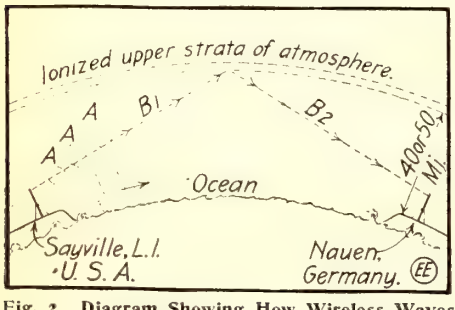


Fig. 2. Diagram Showing How Wireless Waves Are Propagated Over the Earth's Surface.

complement half waves of those shown being, of course, in the earth proper.

It was formerly believed in the early days of wireless telegraphy that the wireless signals were propagated between stations (which were located sufficiently far apart so that the mast of one could not be seen at the second station) by means of what was termed the "bound" ether, locked up or permeating the earth itself and also all other solid bodies with which we come in contact daily.

According to the latest scientific theories of all bodies, even including cast iron, steel, etc., these really consist in great part of etheric electrons; the relative percentage of solid particles in same being extremely small. This theory was at one time strongly advocated by the famous English scientist and investigator, Sir Oliver Lodge.

After much research and experimental work, which has progressed sufficiently to give some basis upon which to stand, some of the leading scientists of the day, including Dr. J. A. Fleming and others, now hold to the *reflected wave* theory to account for long distance radio telegraphy.

This is supposed to take place as follows: As we know, the atmosphere of the earth, roughly speaking, extends upward to a depth of 40 or 50 miles. At these high altitudes the atmosphere becomes very highly rarefied and it is suspected that a very strong ionization of the electrons in these upper strata of the atmosphere takes place. This electrification of the upper strata is caused by the electro-magnetic effect of the sun's rays, according to these theories.

It is believed that, considering such long distance radio transmission as 4,000 miles, the etheric waves, as propagated from a station like Sayville, L. I., strikes upward, due to the earth's curvature. The waves are then reflected from the highly ionized upper strata of the atmosphere; also it is thought further that the reflected wave, such as at B^2, is the one that is intercepted at the distant receiving station, say at Nauen, Germany.

AMERICAN RADIO LEAGUE WIRELESS STATION.

By Frank C. Perkins.

The accompanying illustration shows the equipment of the American Radio League relay wireless station. This station is in operation at New Rochelle, N. Y. The aerial is of the inverted "L" type, having an average (two wire) height of about 65 feet and a length of 180 feet. All the parts of the aerial are extremely well insulated and very strongly installed to prevent damage by wind and sleet. Standard phosphor bronze wire and commercial insulators are used.

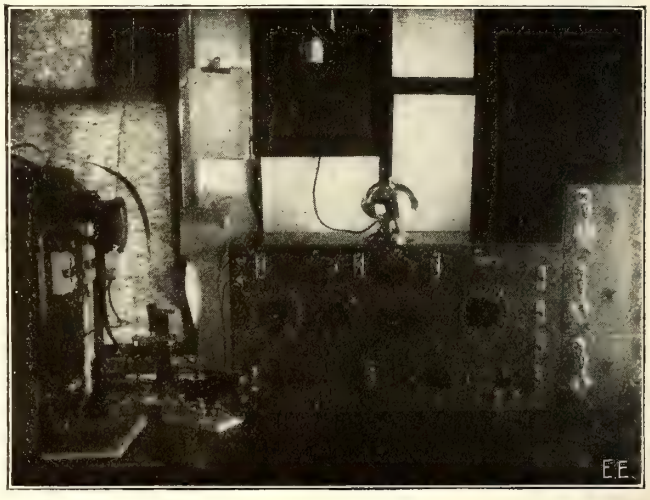
It may be stated that the transmitting set consists of a 1-kw. transmitter, with a condenser capacity of .006 mfd. (three standard Navy jars in parallel). The rotary gap employed has 12 moving points and two stationary electrodes and turns at 8,000 R.P.M. This allows the use of the above small condensers and gives the short wave necessary for 200-meter work in the primary circuit, which together with close tuning through an efficient oscillation transformer, with fair looseness of coupling, allows heavy radiation on a single peaked wave.

It is held that repeated tests show a transmitting range of between 350 and 400 miles under any sort of normal conditions. Under very good atmospheric conditions 800 to 1,000 miles is not at all difficult with this set. The transmitter is contained in a polished wood cabinet, a corner of which may be seen in the extreme left of the picture.

There is a special loose coupler used for waves up to 3,000 meters or a little over. This loose coupler has a very long secondary of high inductance value, which permits tuning without using much capacity across the secondary in that circuit; practically no capacity is used and this method has been found to permit of much longer distance in working, especially with audions. Also the loading coils used load both primary and secondary, and particularly endeavor to balance up the secondary circuit with the use of very little capacity. This method is one of the secrets of the remarkable sensitiveness of this set.

It is of interest to note that No. 24 wire is used for both primary and secondary of the loose coupler. A two-step amplifier of the Audion type is used in connection with an Audion detector. This amplifier embodies some original ideas in its details of construction.

It is pointed out that there is an original arrangement of knob switches in the amplifier circuit that allows (for the first time in actual practise) a change from the receiving on the detector alone to any step of the amplification instantly, without removing and replacing telephones or disturbing any adjustments. This method of producing instantaneous amplification and the reverse is of great convenience and importance. The whole station was designed with the idea of service on long-distance radio "relay" work, and is remarkably efficient in operation. A comparison of effects may be had by noting that Key West station, NAR, can be heard and copied easily 15 feet from the ordinary telephones, while Arlington, NAA, has been copied over 100 feet distant from a loud-speaking telephone when this was hooked up in the circuit. Regular work has been done with stations using 1-inch coils at a distance of nearly 50 miles.



Excellent Radio Relay Station of the American Radio League, at New Rochelle, N. Y.

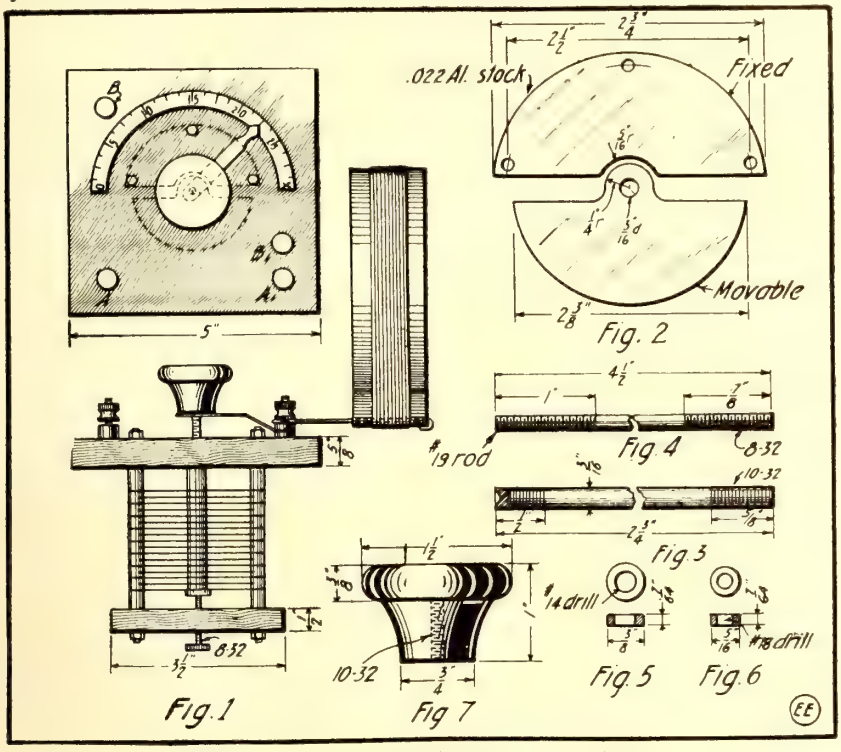
TO INSTALL WIRELESS AT CHICKASHA, OKLA., HIGH SCHOOL.

The Chickasha (Okla.) High School will install a wireless telegraph dispatching and receiving station for use in the school work. The station will have sufficient power to receive messages from the Arlington wireless station on the Eastern coast and from ships 300 miles out in the Gulf of Mexico. The station is now ready for business.

How to Build a Wave Meter

By Samuel Cohen

MANY radio experimenters have an idea that the construction and manipulation of a wave meter is a difficult matter and therefore they do not usually build one. However, the construction and operation of a wave meter is so simple that the novice operator may use it.



Details of Wave Meter Condenser and Inductances.

First and foremost, a wave meter is an instrument comprising an inductance and a variable capacity and an indicating device, such as a telephone receiver or vacuum tube.

This article deals with the construction of a wave meter, which was recently built and calibrated by the writer. The builder of this instrument does not necessarily need to calibrate his wave meter, but he should construct it according to dimensions given.

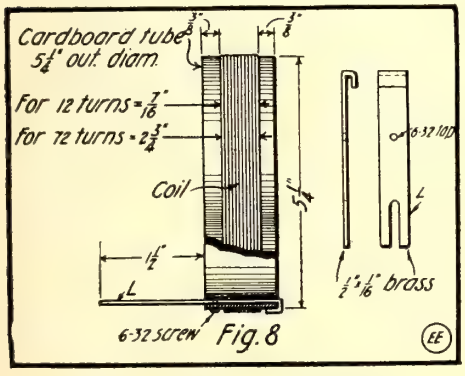


Fig. 8. Inductance Coil Make-Up.

The writer advises the consultation of a good text-book treating on the manipulation and construction of these meters before building such an instrument.

The first thing to build is the condenser, which is of the rotary air dielectric type. Very little explanation is necessary for the description of this condenser, as all the details are plain and self-explanatory. Fifteen rotary and 16 fixed plates of No. 20 B. & S. gauge aluminum are made according to dimensions, as shown in Fig. 2. The rotary plate shaft (3-16-inch diameter stock) is shown in Fig. 3 and stationary plate rods, of which there are three, are made in the same manner, as is shown in Fig. 4. Two sets of washers are constructed, namely, the rotary plate washers, as shown in Fig. 5, and the stationary plate washers, as Fig. 6 illustrates. When all these parts have been made accurately assemble the condenser, Fig. 1. The rotary plates are regulated by means of an 8-32 set screw. The knob, Fig. 7, is made of any insulating material, preferably hard rubber.

This variable condenser has its 180° scale marked off in 30 equal divisions. Its maximum capacity with the rotary plates totally intermeshed with the fixed plates is .000795 micro-farads. At 15 scale divisions the capacity would be half this value in microfarads. The wave length can be calculated from the usual formula:

$$\text{W.L. in meters} = 59.6 \times \sqrt{\text{L. cms.} \times \text{C. m.f.}}$$

We now come to the inductance coils, of which there are two. These are shown in detail as to their make-up at Fig. 8, and some substantial cardboard tubing or wooden rings are to be used, which have an exact outside diameter of 5¼ inches. Two such "forms" or rings are necessary and the smaller inductance coil consists of 12 turns of No. 20 B. & S. enameled magnet wire, wound on very evenly, with the turns close together. The second or larger coil consists of 72 turns of the same size magnet wire, wound on evenly, with the turns close together. The coils may receive a few coats of black shellac to help hold the windings firmly in place. It is also a good idea to bind the coils with white linen tape or with cord, so as to protect the wire from injury.

Both coils are provided with two brass or copper attachment straps L. The drawing at Fig. 8 indicates how these plugs are attached to the card board tubes by simply bending one end of them over as indicated, and a No. 6-32 machine screw is passed through a hole in the other side of the cardboard ring into a tapped hole in the brass strip. These strips should be about 1½ inches apart, and the two terminals of the coil in either case soldered to them, one terminal to each plug. The slots in the ends of the strips are fitted, of course, to the binding post of the wave meter at A^1, B^1.

These inductances correspond to those made by the writer and which are designed from standards as made up and tested on a Siemens & Halske inductance bridge at the radio laboratory of the College of the City of New York. The small or 12-turn coil has 36,000 cms. inductance, while the 72-turn coil has 1,036,000 cms. inductance.

Fig. 9 depicts three curves plotted for different wave lengths, corresponding to different condenser readings. Curve 1 was plotted with the small inductance coil, while curves 2 and 3 represent the use of the large inductance coil. It is very easy then to determine the resonance points of the wave meter by reading the scale setting of the condenser and referring to the curves herewith reproduced. Care should be taken not to use the wrong curve, as they have entirely different values.

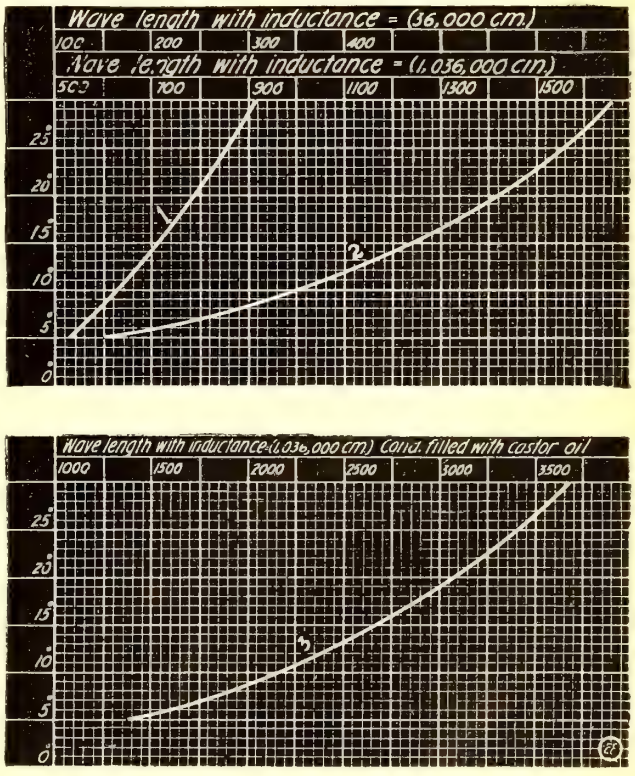
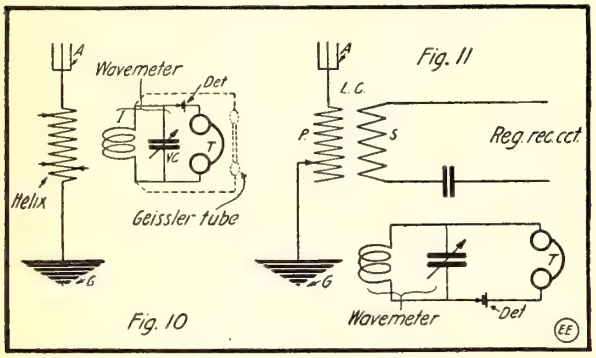


Fig. 9. Wave Length Inductance and Capacity Curves for Use With Wave Meter.

The curve No. 3 was plotted for those desiring to measure waves up to 3,500 me-

ters in length or more. To use this curve and its equivalent wave lengths as given, the variable condenser of the wave meter must be placed in a glass or other jar, so that the moving and fixed plates will be immersed in castor oil. This raises the capacity of the condenser about five times, and hence gives us greater wave length



Figs. 10 and 11. Diagrams for Using Wave Meter on Transmitting and Receiving Circuits.

ranges with the same inductance coil, i. e., 72-turn coil, with 1,036,000 cms.

The diagrams at Figs. 10 and 11 indicate how the wave meter is hooked up. At Fig. 10, used, say for measuring the sending wave length, the inductance coil I of the meter is held *just close enough* to the sending helix so that a *readable sound* is heard in the telephone receivers T. The variable condenser is regulated or turned until the loudest signals are heard. This is the point of resonance in the wave meter circuit, and the corresponding wave length value for this setting of the condenser is read off from the curve 9. If the condenser reading was, say 20 degrees with the large inductance coil in use, then by noting the wave length vertical line intersecting the curve 2 (for large inductance) and the (air) condenser horizontal line, it is seen that the wave length is 1,420 meters.

In a similar way the wave length is measured at a receiving station (see Fig. 11). The wave meter inductance coil is placed in sufficiently close proximity to the loose coupler coils until the incoming signals can be heard in the meter 'phones. The variable condenser is then turned until the signals are heard loudest and this condenser setting in degrees, referred to the curves in Fig. 9 as explained above, gives the equivalent wave length in meters.

Another common method in vogue for measuring received signal wave lengths is as follows: When a certain station is tuned in sharpest on the regular receiving set the instruments are left alone as they set. Then the wave meter is brought near the coupler, etc., and by exciting the wave meter circuit (by connecting a buzzer vibrator across it) it is possible to hear the meter oscillations by induction in the 'phones of the regular receiving set. When the meter signals are heard loudest, then it is set to the wave length corresponding to the setting of the receiving apparatus.

From the data here given it is possible to easily build a wave meter with any rotary condenser, using the standard inductances here cited.

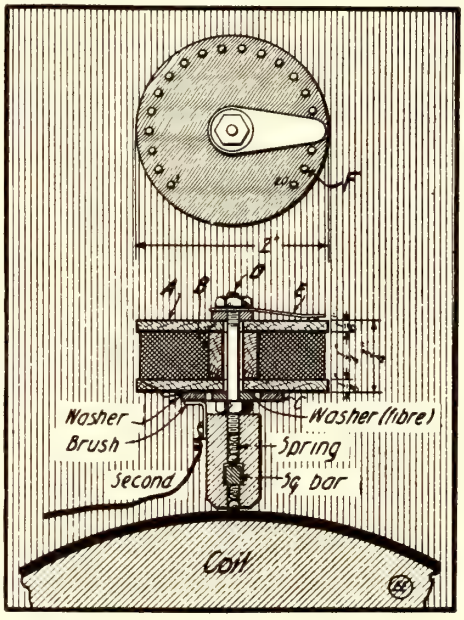
LOADING COIL MOUNTED ON SLIDER.

A miniature loading coil which is placed on top of the loose coupler slider can readily be made, and at the same time have a fairly large wave length. This instrument has been tested out in several commercial radio stations very successfully.

By referring to the drawings herewith given the construction will be quite evident. First comes a circular form A, Fig. 1, which is made of some insulating material, preferably hard rubber, and turned out in a lathe. The dimensions are given. Next mark out a circle having a radius of 1⅜ inches and on it lay out evenly 20 points, and then set in them 20 brass nails having $\frac{3}{16}$-inch shank. After having done this obtain a 1-inch brass or copper washer C and mount it carefully on the circle, as shown. It is fastened in place by means of three brass screws. This ring is used to connect one of the end connections of the winding by a brush, as shown in Fig. 1.

A ¼-inch hole is next drilled in the center of the reel A, and into it force a brass tube ¾ inch long having an internal diameter of $\frac{11}{32}$ inch. Into this brass tube the shaft D is placed, which is made from brass stock, and details are shown in Fig. 2. The contact maker is now made as in drawing 3, which is then soldered to the shaft as seen.

Now, being finished with all the necessary details, the winding is next to be considered. There are 20 sections to be wound on the coil. The first winding consists of 10 turns of No. 36 D. C. C. magnet wire.



Loading Coil Mounted on Tuner Slider.

The one end of this coil is brought to the brass washer C and firmly soldered, while the other end is soldered to the shank of the first brass tack. The second winding consists of 15 turns of the same wire, and the connections are made with the first tack, while the other joins on to the second tack. All the other windings are made in the same way, and each winding is increased by five turns.

The shaft is then screwed on the slider and carefully adjusted to see that the coil rotates easily and that the switch blade makes contact with each point.

Now connect the aerial wire to the brush binding post, while the coil end wire joins the regular receiving circuit. By turning the reel the wave length is regulated, and also the slider can be moved back and forth. This method of tuning is very efficient and at the same time saves some space, besides enabling two operations to be accomplished by the hand in one position.

[*This device has been developed by the Eugene T. Turney Co., which has patents pending on it.*]

ELECTRIC VARNISH.

Powder some common sealing wax in a mortar, place the fragments in a bottle and cover with alcohol. Keep in a warm place until all the sealing wax is dissolved. This varnish may be used to cover magnets and other parts of electrical apparatus.

Electric Cement.

Melt equal parts of beeswax and rosin together and stir in one-fourth of their weight of red ochre, stirring until well mixed. This cement is used for fastening the metal portions of electrical instruments to their insulating supports, etc.

Contributed by
ALEXANDER V. BOLLERER.

THAT LIGHTNING SWITCH.

Every good amateur wireless station has a *lightning switch* to ground the aerial with. The switch is used because it dissipates static aerial currents before they have had time to accumulate into a heavy charge, and thus prevents damage to the building and apparatus.

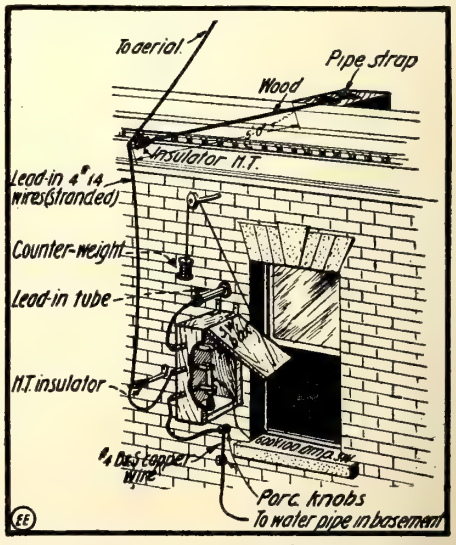
The wire from the switch to earth should be a No. 4 B. & S. (about ¼ inch diameter) copper conductor, connected on the outside of the building and taking a straight course to the ground proper.

This "ground" should consist of a 12-foot by 1-inch diameter iron pipe driven into moist earth, or a 10-inch square piece of copper buried 6 feet deep. Some amateurs use a connection made to a well-pump (iron pipe), but in any case the connection must be soldered and taped.

A 100-ampere, 250 or 600-volt S. P. D. T. switch is specified, with the aerial connected to the blade, the ground to one jaw and the apparatus to the other jaw. This switch may be obtained from any electrical supply company, but in order to stand the sending voltage the base should preferably be made of marble or porcelain. The cheapest way to do this is to buy a slate-base switch and remount on marble yourself.

If the aerial proper is composed of four No. 14 copper wires, then the lead-in should consist of four No. 14 copper wires or a No. 6 B. & S. solid wire, stranded cable being best, of course.

In order to protect the switch from being broken, it should be fastened with screws in a box with a hinged cover, and the lead-in fastened by an insulator before it reaches the switch.

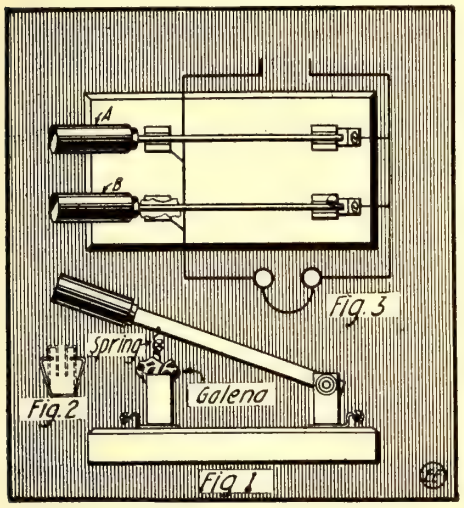


Practical Method of Installing Lightning Switch.

Rain can be prevented from running down the lead-in by making a half loop in it. Contributed by
WM. R. COTTRELL.

AN EFFICIENT DETECTOR.

I give herewith sketch and description of a simple yet efficient detector, made from a double-pole single-throw switch, which I am sure will be found useful to the amateur.



Detector Made From Knife Switch.

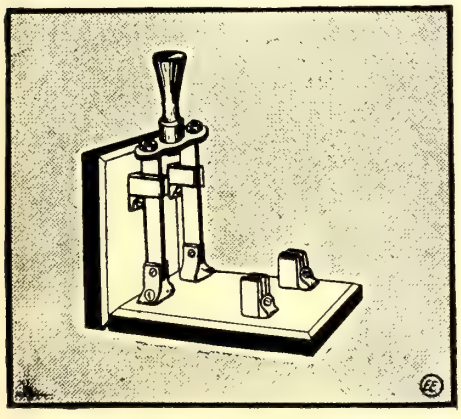
Procure a double-pole, single-throw knife switch; unscrew the hinge post and place a washer between the base and post, so as to allow the switch blade to be swung from side to side to facilitate the adjustment. Before replacing the switch blade, solder on it a fine wire coil of either phosphor-bronze or brass, to make contact with the crystal. Now take jaw post and bend it into shape to hold the crystal, as shown in Fig. 2.

This completes the detector; the other switch being used to short-circuit the detector while sending or it may also be converted into a detector. If the constructor has means of short-circuiting the detector on the antenna switch, and does not need the added detector, he may use a single pole, single throw switch, and will not have to change blades, as in the case of the double-pole, single throw switch, where the double blade will have to be substituted by the single blades. Connections are shown.

Contributed by WILLIAM GUIER.

A HANDY AERIAL SWITCH.

The following instructions will be found very serviceable for constructing an efficient and simple aerial switch at a very nominal cost. This switch may be thrown



Aerial Switch Composed of 2 D. P. S. T. Knife Switches.

from transmitting to receiving, and vice-versa, very quickly and satisfactorily.

Obtain two double pole, single throw switches and from one remove the arm and place the lugs over the arm and lugs of the other. Then tighten to whatever pressure desired. Set the switches at right angles and fasten to either a wall or table. If desired, a special base may be made for this purpose, as sketch indicates. This should be composed of a block of wood, ½x3½x6 inches long, screwed at right angles to another block, ½x3½x6½ inches long, the corners of which may be beveled to produce a neater effect. Contributed by D. K. WALKER.

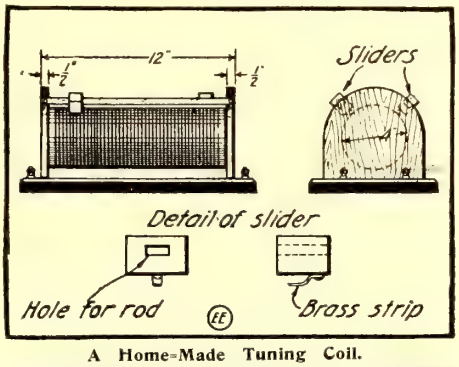
A HOME-MADE TUNING COIL.

The amateur is often hampered by the lack of funds and therefore the tuning coil herewith described will be found beneficial in overcoming this embarrassment.

First a cylinder 4 inches in diameter is made from cardboard and coated with paraffine to insure perfect insulation, or, better still, a wooden cylinder may be used. This cylinder should be 11 inches long and wound with a layer of 20 to 22 copper wires with cotton covering. (Enamel wire will also be found effectual). A rod is now heated red hot and drawn along the coil, thus burning off the cotton insulation in two straight lines, each about ¼ inch wide; these bare strips forming paths where the sliders make contact. For enamel insulation sand paper serves to remove the coating along the slider paths.

A convenient size frame of ½-inch stock is then constructed, across the ends of which are placed two brass slider rods, with a slider on each. These sliders are made from pieces of brass or copper with holes to fit the rod, contact being produced by fastening (soldering) a strip of spring brass or copper onto the under side; while at the top a piece of hard rubber should be firmly fixed to prevent the coil from being grounded through the body. (Sliders can be purchased very cheaply from any supply house). The binding posts can be procured from old dry cells, and in the drawing herewith is shown the make-up, there being four terminals. By properly following the above directions, good results may be realized with this coil.

Contributed by SAMUEL F. DUNN.



A Home-Made Tuning Coil.

SMOKE STACK SUPPORTS WIRELESS AERIALS.

The big smoke stack at the Brush Electric Co.'s power plant at Galveston, Tex., was probably never intended by its designer to be used as a mast to hold wireless aerials, but it has proved a wonderfully good thing for the purpose, and messages are now being transmitted from the top of the smoke stack to points as far away as Vera Cruz.

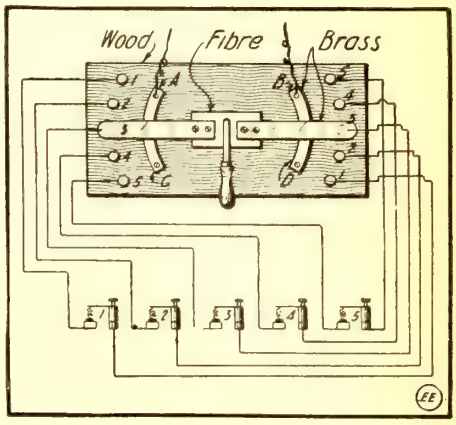
Except for the wireless on the army transport Buford, which was in continuous operation all through the recent storm, the Marconi wireless plant at the Brush power house was the only wireless in the city connecting Galveston with the outside world.

The Marconi aerials went down during the height of the storm and Manager Campbell immediately got busy looking for another place from which to operate.

A HANDY DETECTOR SWITCH.

I have found the following switch very desirable for throwing one of a number of detectors into circuit.

This can be easily made by placing some exploded cartridge shells on a wooden base, as shown in sketch, and connecting these to the two pieces of brass by means of the brass strips, indicated in sketch



Unique Detector Switch.

attached. The sliding brass strips are riveted onto a piece of sheet fiber, through which is bored a hole. A rod is passed through and connected to the wood base. It is then bent, and if desired a handle may be attached.

The figures from 1 to 5 represent the bullet shells and numbers of detectors; and the letters A, B are the connections for the phones and instruments.

Contributed by GORDON SCHAUB.

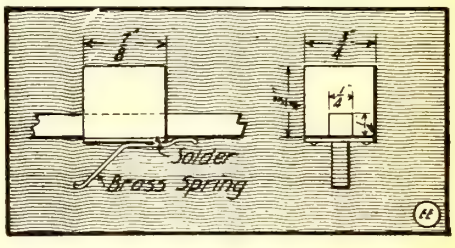
A SIMPLE TUNER SLIDER.

The following articles are required to make this handy little slider:

A piece of hard wood ⅞ in. x ¾ in. x ¾ in., in which a groove ¼ in. x ¼ in. is cut to allow slider to pass through. A sheet of tin or copper ⅞ in. x ¾ in. is fitted over this groove, and screwed or nailed on, as the constructor sees fit. On this is soldered the slider contact, which has been properly shaped and a ½ in. projection allowed, in order to make contact with rod.

This slider works very easily when the slider contact is made of a thin but flexible piece of brass or phosphor bronze. The hard wood handle is now given a coat of shellac and the slider is ready for use.

Contributed by CARL LINXWEILER.



Tuning Coil Slider Made from Wood.

THE CHAMPAIGN, ILL., WIRELESS CLUB.

The Champaign Wireless Club, of Champaign, Ill., was organized Aug. 4, 1915. It has nine members: Maurice Lee, president; Walter Thornhill, vice-president; Joseph Tipiword, secretary; Ernest Mills, treasurer, and T. McHown, S. Hall, S. Bostic, O. Bucker and N. Chatman.

HOW TO MAKE IT



This department will award the following monthly prizes: FIRST PRIZE, $3.00; SECOND PRIZE, $2.00; THIRD PRIZE, $1.00.

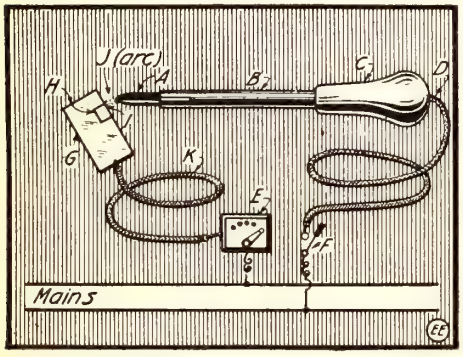
The idea of this department is to accomplish new things with old apparatus or old material, and for the most useful, practical and original idea submitted to the Editors of this department, a monthly series of prizes will be awarded. For the best ideas submitted a prize of $3.00 will be given; for the second best idea a $2.00 prize, and for the third best a prize of $1.00. The article need not be very elaborate, and rough sketches are sufficient. We will make the mechanical drawings.

FIRST PRIZE $3.00.

AN ELECTRIC SOLDERING IRON.

The following is an electric soldering iron that I have found very useful and particularly accessible for niches, corners or tight places, as well as for use in ordinary soldering.

At A is a small carbon pencil, forced into the end of a copper tube B. C is a small wooden file handle, drilled out, so that the copper tube can slide in snugly.



Arc Type Electric Soldering Iron.

At D is seen a single covered conductor soldered on the copper tube B. A small variable resistance coil to regulate the current is depicted at E, while F shows a switch for breaking the circuit. G is the piece that the article H is to be soldered to and I represents the soldering flux; or if desired, solder may be used with acid, provided a small piece is cut off and placed on the article to be soldered. At J is shown the "arc" formed by closing the circuit and holding directly over the article to be soldered. K is another insulated wire to be grounded to the article being soldered.

This iron may be made either large or small, as the builder sees fit. I have had fair success with it and feel sure that other amateurs will also find it efficient.

Contributed by
HAROLD SPAULDING.

TO BORE HOLES IN GLASS.

The following method of making perforations through glass may be of interest:

Take an old triangular file and break off its tip about ½ in. from the end. Place the shank end of the file in a brace and use it as a drill. The glass should be drilled slowly, using kerosene as a lubricant. At first it may be found rather difficult, but after once starting the shape of the file causes it to act as a reamer.

Contributed by W. R. COTTRELL.

FURNITURE POLISH.

Herewith is submitted a formula for making a cheap furniture polish, which will be found very efficacious: One-half gallon gasoline, ½ gallon light lubricating oil, 2 drops of oil of cedar.

Contributed by MONROE MILAN.

SECOND PRIZE $2.00.

AN AUTOMATIC TRANSMITTING KEY.

I give below a description of an automatic key, which, although it may appear complicated, is really very simple.

The first consideration is the base. This is made of oak 4x7x⅞ inches, with ten 5/16-inch holes, drilled and countersunk, as shown in Fig. 1. The lever A, Fig. 1, is composed of a ¼-inch square brass rod, drilled and tapped, as shown in Fig. 2. The contacts X and F¹ (Fig. 1) are for *dashes*. A small silver piece about 3/32 inch in diameter is soldered to the center of the lever, ½ inch from the end at "X." The other contact is soldered to the screw in the post F¹. Two inches from the end a 3/32-inch

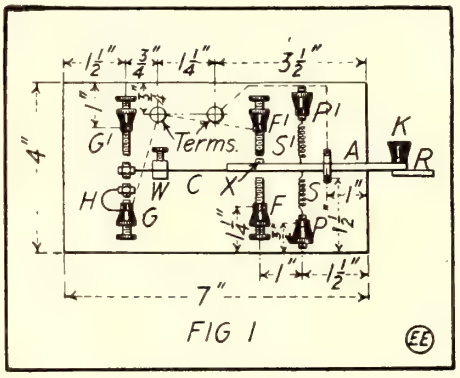
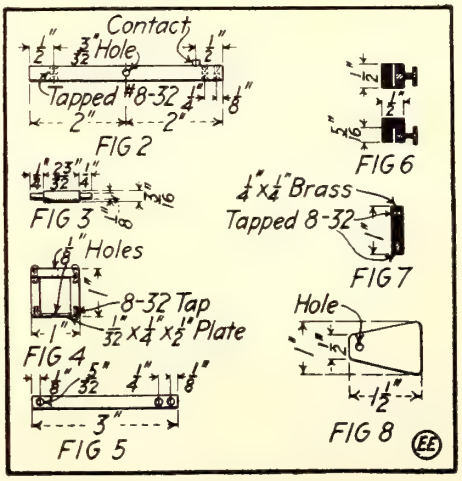


Fig. 1. Assembled Automatic Telegraph Key.

hole is bored, and into this is forced a steel pin, as Fig. 3 depicts. This pin forms the pivot which carries the lever. The bearings are shown in Fig. 4, while R, Fig. 1, is a piece of ⅛-inch hard rubber or fiber sheet, finished as illustrated in Fig. 8. This



Details of Parts for Making Automatic Telegraph Key.

is fastened to the lever by an 8-32 screw ¾ inch long. At K may be seen a hard rubber key knob.

The spring C, Fig. 1, is made of phosphor bronze about No. 32 or 34 B. & S., and measures 3⅛x¼ inches. This makes contact with a 3/32-inch diameter round piece of silver, soldered into a brass cup and bolted on to the spring through a 3/32-inch diameter hole. The weight W is made of brass, ½x½x½ inch. A slot is sawed in the center of the bottom 5/16 inch deep. A set-screw is then placed in one side. The spring H is a U-shaped piece of phosphor bronze 1 inch long and ⅞ inch wide. On one side of the "U," the silver contact is soldered and a 3/32-inch hole is drilled in the other side. The spring is fastened by means of an 8-32 screw to the post G. The four posts F, F¹, G, G¹, Fig. 1, are each 1 inch long by ¼ inch square, as shown in Fig. 7. A ⅛-inch hole is drilled ½ inch deep in the bottom of each and tapped for an 8-32 screw. Four 8-32 screws, with knurled heads and lock nuts about 1 inch long, are required for these posts. The posts P and P¹, Fig. 1, are similar to the others, except that a hole 3/32 inch in diameter is drilled through the post at the top. The screws to which the springs are fastened slide in these holes. The two screws are without heads, but are fitted with knurled lock nuts.

The springs S and S¹, Fig. 1, are made of No. 28 phosphor bronze wire. They are ⅛ inch in diameter and ½ inch long. One end of each spring is attached to one of the screws and the other end to the lever.

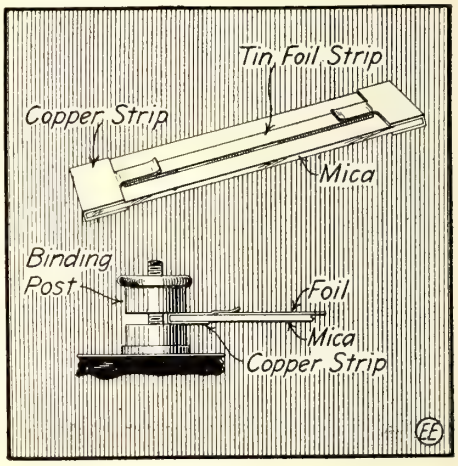
Connections are made between the posts F¹ and G and one binding post; also be-

THIRD PRIZE $1.00.

FUSES FOR BATTERY CIRCUITS.

A small fuse for battery circuits may be made of a small piece of tin-foil. The tin-foil is cut in the form of a narrow strip and connected between two binding posts. Its size will vary according to the current it has to carry. Contributed by

W. R. COTTRELL.



Battery Fuses Made from Tin-Foil and Mica.

tween the lever bearing and the other binding post.

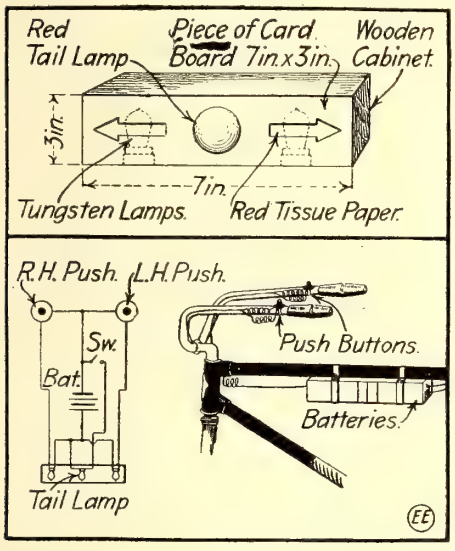
The speed at which the signals can be made may be varied by moving the weight W along the spring.

Contributed by J. L. GREEN.

"SAFETY FIRST" ON THE MOTORCYCLE.

Here is a simple little attachment, the employment of which will insure riders of motor vehicles against accident when turning sharp corners or when driving through dark roads in the country, or otherwise. This device constitutes a "red" rear lamp and two red arrows, which are brilliantly illuminated by the touch of a button. The construction is as follows:

First make a small-sized wooden cabinet about 7x3x3 inches. Take a piece of cardboard cut to the above dimensions, and with a sharp knife cut out, with the aid of a ruler, two arrows, leaving a square space in the center for the rear light. Then procure some red tissue paper, or better, some red glass and glue firmly against the frame of the arrows and rear lamp on the cardboard; cover and allow to dry. Now screw in three miniature lamp receptacles in the base of the cabinet; fasten the lamps, make



Electric Signal for Tail-End of Bicycles and Motorcycles.

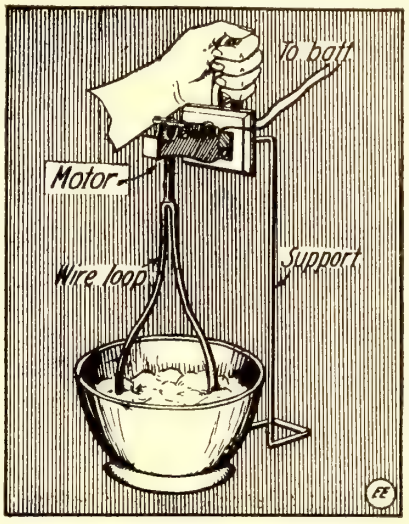
necessary connections and tack the cardboard cover on the frame of cabinet with carpet tacks. The wiring is very simple and the battery may be clamped on the main bar. Two push-buttons, as used on automobiles, are attached to both handlebars and set in connection with the corresponding light.

Whenever it is desired to turn in a certain direction (either right or left) the corresponding button is pushed; the light flares up and any approaching vehicles or pedestrians are informed of the intentions and whereabouts of said motor vehicle, thereby obviating all danger. Contributed by WILLIAM WARTON.

SIMPLE ELECTRIC EGG BEATER FITS ANY BOWL.

A very simple electric egg beater can be made at home and at small expense, as shown in the drawing. The egg beater is so constructed that it fits bowls of varying sizes, thus adding to its convenience and effectiveness

All that is needed is a "toy" electric motor and three pieces of stiff wire. One piece for a handle, one for the blades and the third for a leg or support as shown in the illustration. The motor may be operated by dry batteries or may be attached to the electric light system in circuit with a "bell-ringing" transformer. If batteries are used they should be placed on a shelf or on the back of the table attached to the



Home-Made Electric Egg-Beater.

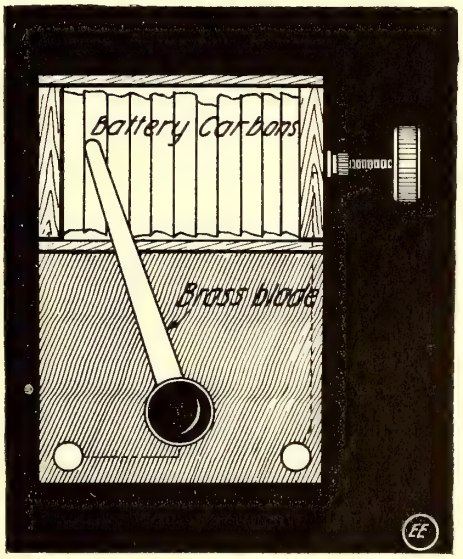
motor by a flexible wire of sufficient length to allow the beater to be used on any part of the table. A small switch should be placed on the motor or within reach of the left hand.

This machine will beat any number of eggs in a very short time and it does not get "tired." Contributed by HAMILTON A. HOOPER.

A USEFUL CARBON BATTERY RHEOSTAT.

Anyone desiring a cheap but extremely efficient rheostat will find that this one will exceed their expectations, both for simplicity of construction and for efficiency in the regulation of battery current.

All that is required to build it is a hard wood baseboard, a number of flashlight or other battery carbons and a switch handle. The carbons are placed in a rectangular compartment made by screwing small strips of wood on both sides and ends of the space they occupy. A strip of wood may be laid across the top to prevent them



Old Battery Carbons Form Useful Rheostat.

from being forced out of place. A hole is then drilled on one side, into which a threaded brass rod is tightly fitted. This rod must have a knurled thumb nut with which to turn it. A brass nut should first be put on the rod, to which is soldered the wire for connection with the binding post.

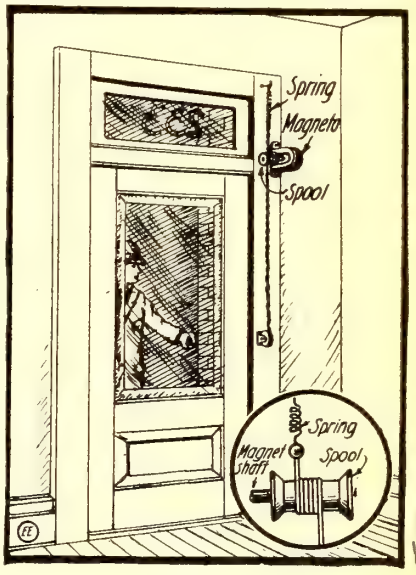
The switch handle is now placed in the center of the remaining space; a block of sufficient thickness being set under it to bring it on a level with the upper surface of the carbons, i.e., with the end of the lever resting on them. Any number of carbons may be used, but it has been found that the more employed the more sensitive will be the regulator.

The regulating screw must come in contact with the carbon near it, or the connection may be made from the carbon itself. By sliding the lever over the carbons, different resistances may be obtained nicely, while the screw serves to adjust each step with fine precision.

Contributed by SELMER WICK.

THE MAGNETO ELECTRIC DOOR BELL.

The disadvantages of the common electric door bell often outweigh its advantages. The batteries are continually running down, due to excessive use or a short circuit, and the button seems to be an irresistible temptation to every youngster



A Magneto Door Bell Saves Batteries.

who delights in sticking a pin in it to keep the bell ringing. Although the bell-ringing transformer does away with battery trouble, it leaves much to be desired.

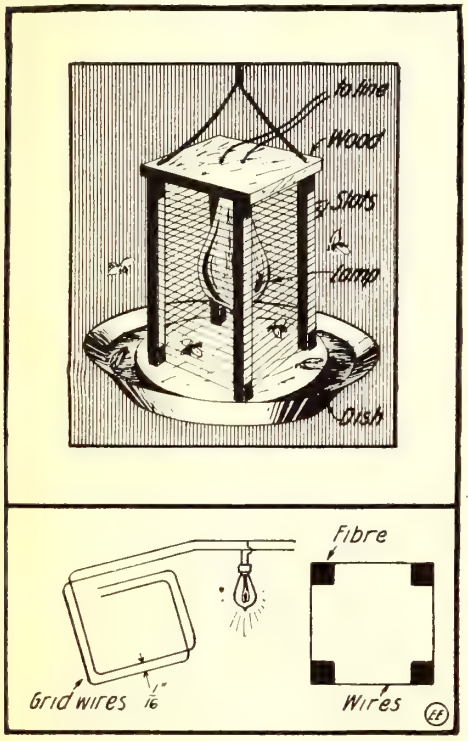
To eliminate all these mishaps I have designed an easily constructed magneto door bell. Purchase a second-hand magneto and a polarized bell. Remove the two brass gears from the magneto and put a small spool on the shaft of the magneto.

The magneto is mounted above the door as per sketch and a cord fastened to the regular pull bell is passed around the spool several times, a tack is driven in to keep it from slipping and the free end of the cord is fastened to a strong spring, hooked into a screw-eye, and screwed into the top of the door frame. Wires are run from the magneto to the bell, which is located in any convenient place. These wires may be quite small, as the bell will ring through an enormous resistance.

A study of the diagram will show that a pull on the handle of the bell will spin the magneto armature and when the handle is released the spring will pull it back, ringing the bell in both cases. Contributed by THOMAS W. BENSON.

ELECTROCUTION TRAP FOR INSECTS.

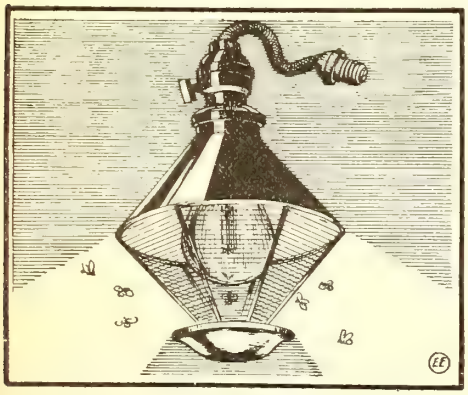
A German inventor has devised a very interesting electrocution trap for insects. Upon an insulated frame of either prismatic or globular form two naked metallic



One Type of Electric Insect Destroyer.

conductors are coiled in a spiral with about 1/16 inch or less space between the windings. The two conductors are connected with a source of electricity in such a manner that the current cannot circulate until it is actually used in killing an insect. This is one of the advantages of the apparatus; obviously no electrical energy is wasted.

Insects are attracted either with sugar water or any other sweet substance. At night time electric lights can be used. The glare of shining metallic parts will also serve as an additional attraction. As soon as the insects touch the bait or the light, and come in contact with any two of the naked wires, they are electrocuted at once and drop down to the bottom of the trap. The current passes only for an instant and is very feeble.



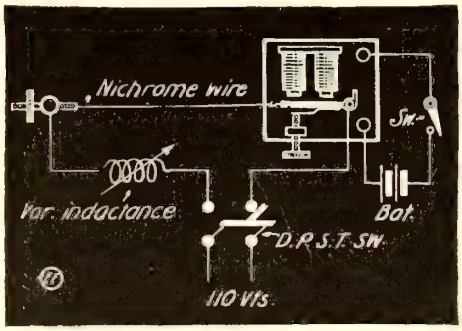
Another Form of Electric Insect Trap.

The sketch herewith depicts how, with a few pieces of horn fiber rod carrying the net of twin wires, with a lamp inside it, one of these useful devices can be made. A tin pan can be fastened to the bottom of the fiber strips in which to catch the dead insects. The top support can be of wax-impregnated wood or of fiber. Slots should be cut 1/16 inch apart in the strips to accommodate the two bare wires. No connection exists between the wires until the insect "crosses" them.

Our second illustration shows a similar style electrical insect trap or annihilator, and in this case the fiber or other strips supporting the two parallel, oppositely charged electrical conductors, are tapered as shown. At the base of these fiber uprights supporting the two charged wires is suitably secured a small cup, in which honey or some other insect delicacy may be placed. An electric bulb, as usual in this class of apparatus, is placed inside the wire cage as in the previous design described above. A single switch may control both the light and the grid wires, as becomes evident.

MECHANICAL WAVES MADE VISIBLE ELECTRICALLY.

The following is a description of a novel and very interesting experiment, which is very easily performed, showing the stationary mechanical waves on a heated electric wire. Resistance wire is used to render it luminous, therefore the room should be darkened to obtain the best effects. I have tried two sizes of "Nichrome" wire; No. 19 gauge, of which about 12 feet was used, and about 6 feet of No. 24. The exact length for 110 volts may be determined by the experimenter; or, better still, a variable impedance coil may be used, in which event, the length of wire need not



Making Mechanical Waves on Wire Visible.

be so exact. At any rate, the wire must be between a dull red and a white heat.

To produce the motion of the wire a buzzer is used to set up mechanical waves. Not having a buzzer on hand I used a bell with the clapper rod cut off as short as possible and the end bent to form a hook. The resistance wire is fastened to the hook, where one side of the 110-volt circuit is connected. The wire is stretched out to the desired length, where the other side of the circuit is connected; the impedance coil being in series with it, as diagram shows.

The switch for the buzzer circuit should now be closed and the room darkened. By means of the adjustable impedance coil regulator switch the wire should be raised to the desired temperature and tightened up again, as it expands when heated.

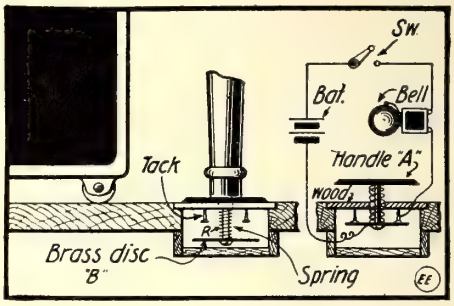
By varying the tension of the wire the waves may be observed. When the correct tension is obtained it should be kept constant. The loops or anti-nodes, and nodes of motion. can be easily seen. The loop is the maximum of motion, which is easily observed, as it cools quicker and will be at a "red heat" when the node is "white."

During the course of one experiment the wire broke. In my haste to repair it I made a loose joint. The resistance of the joint being high, it became luminous, while the rest of the wire remained invisible. The fantastic shapes and figures emanating from the juncture produced a very beautiful and spectacular effect in the darkened room.

Contributed by R. E. RYBERG.

A "SAFE" BURGLAR ALARM.

Its mechanism is so simple and accurate that it can be thoroughly relied upon. The only thing necessary is to chisel out neatly one of your floor boards near your safe or valuables, about 2 inches in length. To make the device, bore a hole in a block of wood big enough so as to admit rod "R" as shown. On the top end fasten a hard rub-



Removing Chair From Spring Switch Gives Alarm.

ber disc "A." At the bottom end a disc of spring brass. Fasten two common tacks and make necessary connections. Explanation: Place a chair on the side of your safe as shown in figure so that one of the legs rests on the top of "R." You have now set the alarm. As soon as the intruder comes to the safe he removes the innocent looking chair, which naturally is in his way, and the pressure of the spring in the device consequently pushes up the shaft, whereupon the brass disc "B" is connected with the bell and closes the circuit. But the initiated can remove the chair as he pleases, provided the switch is off.

Contributed by JAMES BERK.

TO RENEW DRY CELLS.

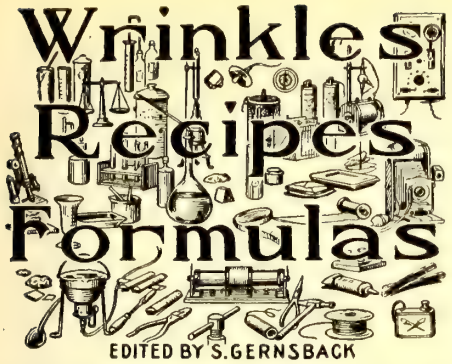
Dry cells, if not too far spent, can be renewed by drilling (not punching) a hole (A) between the binding posts (B-B) and pouring chemically pure ammonia into it. The hole is then sealed up with wax and as efficient service as when it was new can be obtained from the renovated



Method of Revitalizing Dry Cells.

battery. The ammonia will cost little if bought in jars at a time and preserved for future use.

Contributed by A. BEL JEA.



Under this heading we will publish every month useful information in Mechanics, Electricity and Chemistry. We shall be pleased, of course, to have our readers send us any recipes, formulas, wrinkles, new ideas, etc., useful to the experimenter, which will be duly paid for, upon publication, if acceptable.

FORMULA 15.

Blackings for Boots and Shoes.

1. *French Paste for Patent Leather.*—Take 6 drm. of *Pure Wax*, 2 oz. of *Olive Oil*. The wax has to be melted in a water bath. Mix thoroughly by stirring; heat moderately. Add ½ oz. of *Oil of Turpentine* and ½ oz. of *Oil of Lavender*. The mixture will form a paste, which should be put in boxes before it becomes cool. Apply with a linen rag. A very good paste, which keeps the leather *soft and restores the gloss.*

2. *Dressing for Tan Shoes.*—Take 1 oz. of *Annatto*, 1 oz. of *Gamboge*, 1 oz. of *Acacia*, 2 oz. of *Catechu*, 2 oz. of *Hydrochloric Acid*. Add water enough to make 40 ounces.

3. *Polish for Tan and Russet Shoes.*—1 oz. of *Dark Yellow Wax*, 3 oz. of *Oil of Turpentine*, 1 oz. of *Palm Oil*, 15 min. of *Oil of Mirban*. Melt the wax and oil together, add the turpentine, and, when nearly cool, the oil of Mirban.

4. *French Boot Blacking.*—Dissolve 150 parts of *Wax* and 15 parts of *Tallow* in a mixture of 200 parts of *Linseed Oil*, 20 parts of *Litharge*, 100 parts of *Molasses* at a temperature of 250° F. After this add 103 parts of *Lampblack*. When cool dilute the mixture with 280 parts of *Spirits of Turpentine*, and finally mix with a solution of 5 parts of *Gum Lac* and 2 parts of *Aniline Violet* in 35 parts of *Alcohol*.

5. *German Boot Blacking.*—Melt together 90 parts of *Ceresine* (or *Beeswax*), 30 parts of *Oil of Spermaceti*, 350 parts of *Spirits of Turpentine*, with 20 parts of *Asphalt Varnish*. Add 10 parts of *Borax*, 20 parts of *Lampblack*, 10 parts of *Prussion Blue*, 5 parts of *Nitro-Benzol*.

6. *Self-Shining Blacking.*—Dissolve 8 oz. of *Gum Arabic* in 8 oz. of best *Black Ink*; add 2 oz. of *Olive Oil*. Mix thoroughly and then add 4 oz. of *Strong Vinegar*, 3 oz. of *Brown Sugar*, 2 oz. of *Alcohol*.

7. *Waterproof Blacking.*—Melt together 3 oz. of *Beeswax* and 3 oz. of *Black Resin*; then stir in 1 pt. of *Boiled Oil*. When it has cooled a little add 3 oz. of *Oil of Turpentine*.

8. *Russian Waterproof Boot Blacking.*—Melt 1 oz. of *Beeswax*, ½ oz. of *Suet*, 2 oz. of *Olive Oil*. Add ½ oz. of *Lampblack* and stir till cool. Warm the boots and apply the blacking.

9. *Liquid Shoe Blacking.*—5 oz. of *Animal Charcoal*, 4 oz. of *Molasses*, ¾ oz. *Sweet Oil*. Triturate until the oil is thoroughly incorporated, then stir in ¼ pint of *Vinegar* and ¼ pint of *Beer Lees*.

10. *Finishing Blacking.*—Mix together ½ oz. of *Gelatine*, ½ oz. of *Indigo*, 1 oz. of *Logwood Extract*, 2 oz. of *Crown Soap*, 8 oz. of *Softened Glue*, 1 qt. of *Vinegar*. Heat the whole over a slow fire and stir till thoroughly mixed. Apply with a soft brush and polish with a woolen cloth.

S. G.

A GOOD SILVER-PLATING SOLUTION.

This solution will be found of excellent use in silver-plating different parts of electrical apparatus, jewelry, etc. Copper, Brass and German silver articles only can be plated.

Cut a silver quarter into small pieces and place in a porcelain or glass dish. Place the dish, uncovered, in a pan of warm water and add ½ ounce of nitric acid to the metal. Let dish stand in the water until metal is all dissolved. Now add ½ gill of water and one teaspoonful of fine salt. Let the precipitate settle and filter. Add more salt to the filtrate, and if any more precipitate falls filter again. Wash the precipitate on the filter paper until the water shows no acid when tested with filter paper. Add one pint of water to the precipitate and four scruples of potassium cyanide. Great care must be used in handling the cyanide, or the solution after it is added, as it is a deadly and almost instantaneous poison. Put a piece of zinc about 2x1x⅛ inches in the solution and it is ready for use.

No electric battery is needed. Simply clean the articles to be plated in a hot potash solution and rinse good in boiling water. Immerse in the solution for about ½ minute, allowing the article to rest on the zinc. Wipe dry with a cloth and repeat. Heavier coatings can be given by repeating. Articles will take a high polish and wear fine.

Contributed by E. E. ZANDER.

A HANDY SPIRIT LAMP.

All that is needed to make this useful little spirit lamp are: An old ink or mucilage bottle, a wooden cork, a small tube, a piece of asbestos and an old lamp wick.



Useful Alcohol Torch.

The cork should be made of hard wood and as seen in the diagram should have a hole bored through its center. Through this a piece of metal tubing about 1½ inches long is inserted. There should be a notch cut in the side of the cork to admit air.

A piece of asbestos should be procured (a piece of an old asbestos shingle will do) about one inch in diameter with a hole bored through the center to admit the tube. The wick, which may be flat, should be run up through the tube to the desired height. Wood alcohol should be used as fuel as it gives intense heat and little smoke.

Contributed by HARRY RIDINGER.

CONVERSION OF RECIPE FORMULAS.

Sometimes amateurs see a formula or recipe which they might want to use, but cannot do so because the ingredients are expressed in "parts." A part in the sense of the word might mean anything. If specified in solids, it might mean anywhere from a grain to a ton; or if in liquids, might mean anywhere from a drop to a barrel; but if one should keep to the unit and use multiples it would be impossible to make a mistake.

For example, if the formula should say: Use 1 part of nitric acid, 2 parts of potassium bichromate (saturated solution), 5 parts of water (apologies to S. G. in *Electrical Experimenter*, April, 1915, under "Wrinkles, Recipes and Formulas," No. 3); all that is necessary would be to designate the exact quantity that the part represents; then, if one grain for solids and one minim for liquids should be used, the above formula would work out as follows: Nitric acid, 1 minim; potassium bichromate, 2 grains, and water, 5 minims. Of course, this can be multiplied to any proportion.

For further reference the following table will also be found very useful:

No. of parts.	Grains.	Minims.	*Grams., or c. c.
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
10	10	10	10
20	1 scr.	20	20
50	50	50	50
60	1 dr.	1 dr.	60
100	1 dr. 2 scr.	1 dr. 40 min.	100
250	½ oz. 32 grs.	1 dr. 40 min.	250
500	1 oz. 62 grs.	½ oz. 10 min.	500
1,000	2¼ oz. 16 grs.	2 oz. 40 min.	1,000
2,500	5½ oz. 94 grs.	5 oz. 1 dr. 40 min.	2,500
5,000	11¼ oz. 79 grs.	10 oz. 3 dr. 20 min.	5,000
10,000	1 lb. 6¾ oz. 49 grs.	20 oz. 6 dr. 40 min.	10,000

*Metric system: Figures for grammes and cubic centimeters are the same.

It would be advisable for experimenters to copy the above table and put it in a convenient place in the laboratory, as it will be found very helpful for the rapid calculation of parts into liquids or solids, as the case might be. Contributed by

A. WILSDON.

CANNED HEAT.

Canned heat, a new discovery, is nothing else but solidified alcohol. The alcohol is suspended in a soap mixture so that it may be used for heating purposes and still not be open to the dangers from alcohol when burned alone.

Solidified alcohol may be made according to the following formula: Stearic acid, 8½ grammes; caustic soda, 1-35/100 grammes; alcohol (grain or denatured), sufficient quantity to make 100 grammes.

Dissolve the stearic acid in about 50 grammes of alcohol by the aid of heat. Dissolve the caustic soda in about 40 grammes of alcohol. Mix and warm until the two solutions combine. Pour into suitable moulds. The moulds ordinarily used are friction-top tin cans capable of holding three or four fluid ounces. To ignite, the cover is removed and a lighted match held over the solid mixture. To extinguish, the cover is slipped on the can. Care should be taken not to tip over a lighted can, as when the mixture is burning it becomes a semi-liquid and, therefore, a source of danger if spilled. When the fire is extinguished and the mass allowed to cool the contents of the can again solidifies. The soap itself does not burn but is left in the can after the spirit has been consumed. Contributed by

ROBT. H. GYSEL.

WITH THE AMATEURS

Our Amateur Radio Station Contest is open to all readers, whether subscribers or not. The photos are judged for best arrangement and efficiency of the apparatus. To increase the interest of this department we make it a rule not to publish photos of stations unaccompanied by that of the owner. Dark photos preferred to light toned ones. We pay each month $3.00 prize for the best photo. Make your description brief. Address the Editor.

AMATEUR RADIO STATION CONTEST.

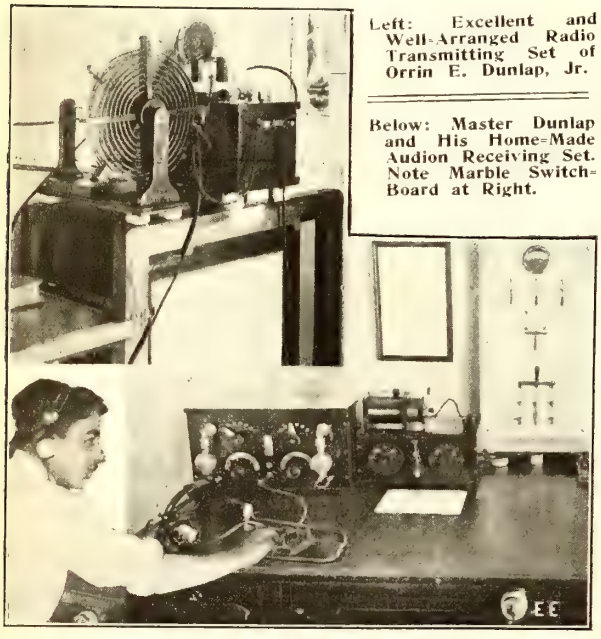
Monthly Prize, $3.00.

This month's prize winner.

RADIO NIAGARA STATION.

The accompanying photographs show the radio Niagara station and serve to clearly show the exterior appearance of the apparatus, so that only a brief description of details need be given.

The complete receiving equipment is home-made, having been built by myself. In the rear of the audion cabinet is a 1 to 1 ratio transformer for the amplifier. In place of the flashlight cells, which are so commonly used with the audion, I use ordinary dry cells which have been discarded from automobiles. There are two sets; 44 cells in a set. The tuning apparatus is mounted on a separate mahogany cabinet and can be used as a *portable set* if necessary. With this set I have heard Colon, Key West and many other distant stations.



Left: Excellent and Well-Arranged Radio Transmitting Set of Orrin E. Dunlap, Jr.

Below: Master Dunlap and His Home-Made Audion Receiving Set. Note Marble Switch-Board at Right.

The transmitter consists of a ¼-K. W. Blitzen transformer, rack type condenser, made up of 10 double flint glass plates. Only four plates are employed on ¼ K. W. The oscillation transformer is the AMCO type. The rotary gap is of the Clapp Eastham type.

I worked I. Z. L. of Northampton, Mass., regularly throughout the winter. The signals have also been heard in Vineland, N. J., Waynesfield, O., and at Ann Arbor, Mich.

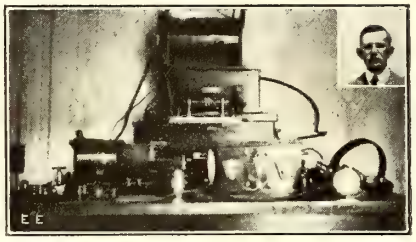
The aerial consists of six wires, 85 feet long, 70 feet high.

ORRIN E. DUNLAP, JR

Niagara Falls, N. Y.

MR. GITTELBAUER'S RADIO SET.

My radio transmitting set comprises: A ½ K. W. transformer, 2 units each ¼ K. W., plate glass condenser, fixed gap, oscillation transformer, "Boston" type sending key, aerial change-over switch, pilot lamp and a protective device across the 110-volt line to provide against kick-backs.



Mr. Gittelbauer and His Neat Radio Set.

The receiving set includes: Loose-coupled tuner, aerial loading inductance, Audion detector, galena and silicon detector, also a "Crystaloi" detector with a cohering inductance.

Normal sending range 40 miles. Normal receiving range 500 miles, but can copy high power stations 1,200 miles.

The aerial consists of three wires (stranded copper) 70 feet long, stretched between two poles 52 feet high at one end, 46 feet high at other end. Ground: Three pipes, each driven 10 feet into moist earth. Aerial when not in use is grounded through a standard 100-ampere knife switch.

I hold a first grade commercial license, in addition to amateur license, and am a member of the American Radio Relay League. My official call is "2 A. Y."

FREDK. GITTELBAUER.

East Rutherford, N. J.

AMATEUR OUTFIT OF BERT ROUTLEDGE.

I give you herewith a photo and description of my wireless station. Some of the apparatus is of commercial make, while the others are home-made. The transmitting apparatus comprises the following: One-inch spark coil, rotary and open spark gaps, two Leyden jars, helix, key and necessary switches.



Radio Station of Bert Routledge.

For receiving, I use successfully a loose coupler, two loading coils, variometer, two variable condensers, one fixed condenser, silicon and galena detectors, 2,000-ohm head-sets and buzzer to test out detectors.

My aerial consists of four wires, each 95 feet long, spread 2 feet apart. It is 55 feet high at one end and 45 feet high at the other. I also have a smaller aerial for sending. The war has effected the temporary closing of my station.

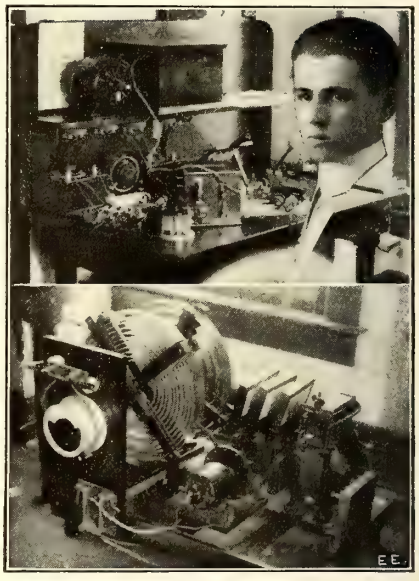
BERT ROUTLEDGE.

Sydney, C. B., Canada.

ROY C. BURR'S RADIO STATION.

The following is a description of my amateur station:

My aerial is made up of 7-strand No. 22 copper cable, 65 feet long and 50 feet high, located on a hill. For ground I use a large copper plate buried 10 feet in wet clay, also gas and water pipes. For sending I use 888 watt Thordarson transformer, 6 Murdock condenser sections, Blitzen rotary, oscillation transformer, Precision H. W. meter and 2 resistance rod kick-back preventers. All connections are of heavy copper bar and transmitter is mounted on plate glass base. 1 K. W. glass plate condenser and rotary quenched gap of my own construction are also included in this set.



Excellent Radio Equipment of Roy C. Burr.

My receiving set constitutes the following; 2 .01 M. F. variables, type D Clapp-Eastham tuner, R. J. 5 audion and galena detectors. Switch is provided for changing from audion to galena or vice versa. Five Blitzen duplex loose coupled loaders increase the tuning range considerably.

With the above set I have listened to a number of stations very clearly, including

such stations as 2 J.D. (New York City), 8 Q.J. (Detroit, Mich.), 9 B.D. (Superior, Wis.), 9 X.N., and many others.

This is a star station for the American Radio Relay League, and also a member of the Central Radio Association. Any experimenter who would like to communicate with this station is cordially invited to do so, my call being 8 R.D.

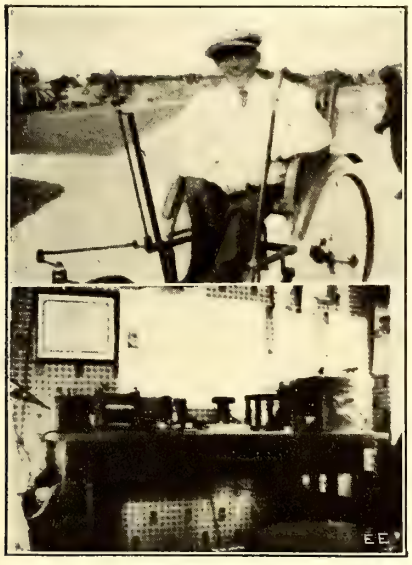
Norwalk, O. ROY C. BURR.

WIRELESS EQUIPMENT OF HAROLD C. SNOW.

Herewith I tender photos of my station and myself for entrance in your Amateur Station Contest.

The aerial utilized is of the "L" type, 90 feet long and 50 feet high, composed of 8 copper wires 2 feet apart. The receiving set comprises a Murdock loose coupler, rotary variable condenser, Perikon and Silicon detectors, 2,000-ohm head-set, and loading coil for long waves. With this set I am able to hear N.A.A. (Arlington) at all times of the day, and have frequently received signals from N.A.X. (Colon, Panama), N.A.R. (Key West, Fla.), N.A.W. (San Juan, P. R.) and N.A.W. (Guantanamo, Cuba), as well as many other Government and commercial stations.

The transmitting set is composed of a Blitzen type ¼-k.w. capacity oscillation



Harold Snow Finds His Radio Set of Great Interest.

transformer, glass plate condenser and sending key; a quick throw switch is used to change from receiving to sending.

I have a First Grade Amateur License and my call is 4 G.A. I shall be very pleased to hear from any other wireless operators.

HAROLD C. SNOW.

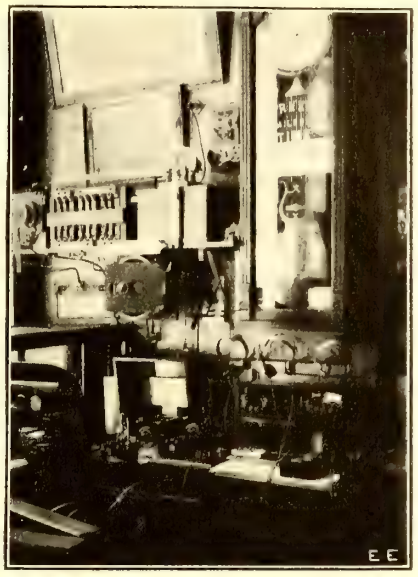
Swampscott, Mass.

W. O. HORNER'S TRIPLE VALVE STATION.

The photo herewith shown depicts my new transmitting and receiving station. My station comprises a 1-k.w. Clapp-Eastham transformer, condenser, rotary spark gap, improved oscillation transformer, hot wire ammeter, kick-back preventer and Blitzen wave-meter.

With this set I have heard Arlington time signals during the day 15 feet from the 'phones, and the 10 P. M. night signals as far as 90 feet during cold weather.

The triple valve audion receiver case is solid mahogany. I have been experimenting with the 1st or tuning audion, and find by placing a permanent magnet around the bulb on a line with grid and wing and by delivering the proper or exact amount of current to the filament, the bulb will suddenly begin to oscillate, and I can then pick



Efficient Radio Station of W. O. Horner, on Which Time Signals Are Audible 90 Feet from 'Phones.

up several *undamped* wave stations on the Atlantic and Pacific coasts.

W. O. HORNER.

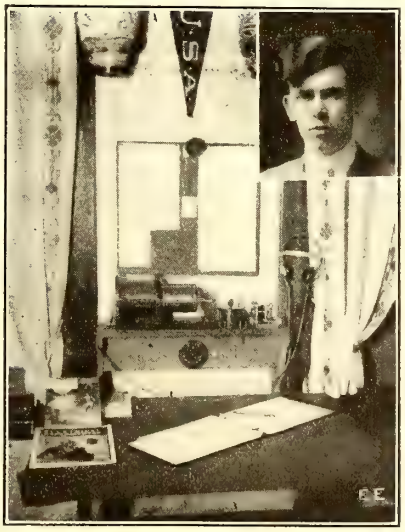
Cleveland, Tenn.

STANLEY CARROLL'S EFFICIENT RADIO OUTFIT.

The following is a description of my wireless receiving station located at Marietta, O. My set comprises an "Electro" professional loose coupler. A Murdock variable condenser and its silicon detector, No. 322, with condenser inside it, with suitable capacity, and the "Electro" loading coil. My range at night includes Key West and Arlington. My aerial is of No. 14 wire, 112 ft. long, of four strands, with 7½ ft. spreaders, 90 ft. high at one end, 65 ft. at the other. Aerial points westward. Am going to build a new aerial this fall just twice the size of my present one, and intend to get a ½ kilowatt sending set.

STANLEY W. CARROLL.

Marietta, Ohio.



Stanley Carroll and His Wireless Set.

Do you realize that with his issue *The Electrical Experimenter* contains 72 pages?

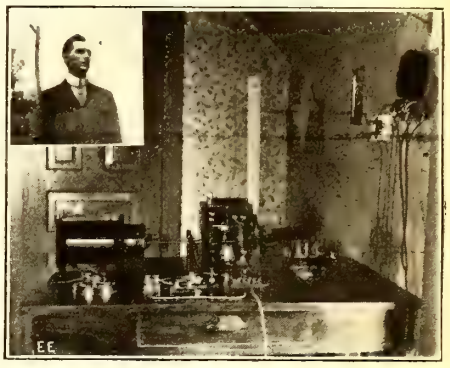
WIRELESS STATION OF C. E. LAWSON.

Herewith is a picture of my wireless receiving set and aerial, which I hope to see published.

The receiving set comprises the following instruments: 2,500-meter loose coupler, 5,000-meter E. I. Co. loading coil, Junior fixed condenser, 2,000-ohm "Electro" amateur head set, "cat-whisker" galena detector, Murdock fixed condenser, Audion detector, pole-changing switch for throwing quickly from one detector to another, "Electro" baby switch for breaking crystal detector circuit when using Audion, and also marble-base lightning switch (not shown in illustration), in order to conform to underwriters' rules. Audion batteries are concealed in drawer of table. All woodwork is mahogany finish. On the right end of table will be seen my wire telegraph set.

The aerial consists of six strands of "Antenium" aerial wire, is 30 feet high at one end and 20 feet at the other end, 75 feet long and connected loop fashion, "L" type, in order to get the maximum wave length for receiving from high-power stations. My ground is No. 4 copper wire soldered to water pipe, and is about 15 feet long.

With the above set I can hear, any night in the year, the time signals from Arlington, Va., and Key West, Fla. I have also heard the Sayville, L. I., station at night, at



Particularly Neat Radio Station of C. E. Lawson.

favorable times of the year, and can hear the U. S. Naval stations at Charleston, S. C.; New Orleans, La.; Savannah, Ga., and Beaufort, N. C., as well as various near-by and smaller amateur stations.

This is, I consider, a very good record for so small an aerial, and I believe is due to the fact that all my connections are soldered and the wiring as simple and direct as possible.

I would like to exchange photos of my set with other amateurs.

CLARENCE E. LAWSON.

Cleveland, Tenn.

NEW RADIO CLUB IN BANGOR, ME.

The Penobscot Radio Club, of Bangor, Me., was organized recently and the following officers were elected: Harold Grant, president; Roy N. Johnson, vice-president; William J. Anderson, secretary and treasurer.

The other members are: William Hall, Cornelius Sullivan, Wainwright Reed and Edward Frey.

All the members have up-to-date apparatus. Meetings are held weekly at the home of the president. The club members would like to communicate with other radio clubs and exchange photos of amateur sets with other amateurs. Address all communications to William J. Anderson, 122 Lincoln street, Bangor, Me.

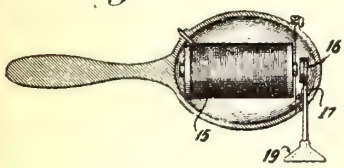
LATEST PATENTS

A. C. Massage Vibrator.

(No. 1,149,099; issued to Leo J. Wahl and Edward W. Wahl.)

The patentees of this device intend that it shall be used on alternating current circuits and in this

Fig. 1



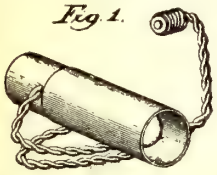
way a vibratory electro-magnetic force is caused to act from the electromagnet coil 15 on to an iron armature 16, which is attached to a pivoted, spring mounted, arm 17. On the end of the arm is a rubber applicator cup 19. The operation of the device is self-evident and it is very simple, magnetically considered.

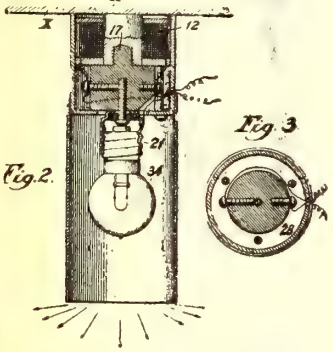
Portable Electric Trouble Lamp.

(No. 1,148,662; issued to Oliver C. Dennis.)

This invention provides for a small electric trouble lamp, suitable for use about automobile engines, ma-

Fig. 1.



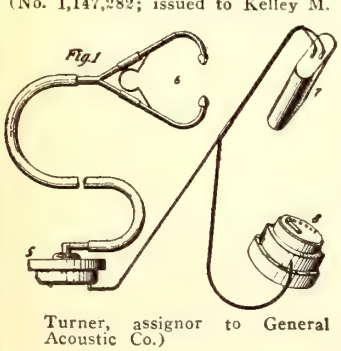


chine work, etc., and includes a strong magnet coil mounted in the base of same. This magnet coil 12, is connected in multiple with the electric lamp itself and is thus supplied with current from a common battery, such as that used for ignition on the car. The central core of the coil 12, is of iron, as is also the outside shell surrounding the coil. The magnetic flux passes out of the core 11, through the iron body, on which it may happen to rest at X, and so back into the second pole face, comprising the outer shell.

Electric Stethoscope.

(No. 1,147,282; issued to Kelley M. Turner, assignor to General Acoustic Co.)

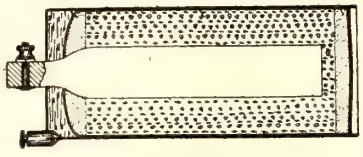
Fig. 1



An improved form of stethoscope, utilizing the well-known dictagraph principle and therefore being of remarkable sensitivity. The specially arranged microphone and controlling rheostat 8 co-acts with a loud talking receiver 5 and the vibrations of its diaphragm are reproduced acoustically through the tube and ear pieces 6. A small battery, of the flashlight type 7, provides current for this system. The inventor claims that several parties can listen to the heart beats and also to the actual character of the beats simultaneously; owing to the greatly amplified strength of the beats, as reproduced by this dictagraph apparatus. A much desired improvement it seems.

Electric Dry Battery.

(No. 1,147,753; issued to Leo J. Schatzel, assignor of one-half to Oscar V. Maurer.)



A new style of dry battery cell made up in the usual manner, as illustration shows. Improvement consists in using as a depolarizer a persulphate of one of the following metals: Barium, strontium, ammonium, copper, manganese, calcium, sodium, lithium or potassium. Of these, however, potassium persulphate is the salt of persulphuric acid, which produces the most marked results. Such batteries yield 2 volts and the life of the battery, as well as its recuperative powers, is said to be well above that of any common cell heretofore manufactured. Complete formulae are given in the patent for making the entire cell.

New Wireless Head 'Phone.

(No. 1,148,941; issued to Harry B. Wier, assignor to Western Electric Co.)

Several good features are incorporated in this patent for an improved wireless head telephone receiver. Firstly, the receiver is adjustable to practically any position desired, by means of the swivel frame and trunnion 35 and 36.

Fig. 1

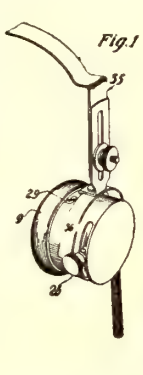


Fig. 2

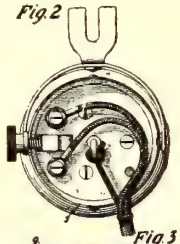
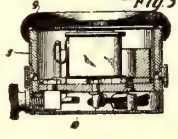


Fig. 3



Secondly, the magnet poles may be adjusted to a greater or less distance from the diaphragm by means of a sliding thumb nut 26, attached to a threaded base plate 10, adjustably mounted inside the receiver shell. The nut 26 can be clamped at any position desired and the receiver is thus adjustable for different signals and frequencies. Further, the cap 9 and the inside shell 5 may be removed from the base shell by means of a bayonet joint 29.

Search-Light for Revolvers and Guns.

(No. 1,149,705; issued to Eugene S. Ward.)

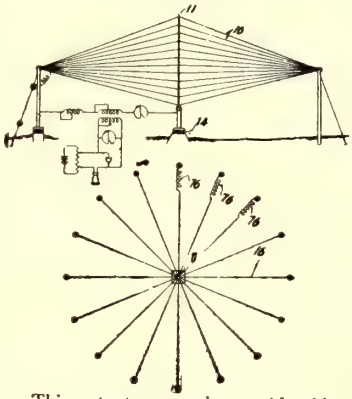
A modified form of electric flash-



light with small size battery, which may be contained in the handle of a revolver, etc. The flashlight bulb is placed in a metal tube attachable to the under side of a revolver or gun. This tube has a sliding tube on same, so that the lens which it carries can be focused for the best results in any case.

Wireless Antenna.

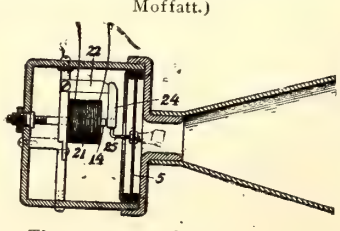
(No. 1,147,010; issued to Reginald A. Fessenden, assignor by mesne assignments to Samuel M. Kintner and Halsey M. Barrett.)



This patent covers in considerable detail the special form of umbrella antenna for radiotelegraphy, as used by Prof. R. A. Fessenden, at the Brant Rock station in Massachusetts. The illustration shows how the various guy wires 16, spaced radially about the 400-foot steel pipe mast 11, form a part of the aerial proper. The entire mast rests on an insulating glass base 14, and the patent covers methods for either using or not using the steel pipe mast as part of the aerial system. Also powerful spring shock or mechanical tension absorbers 76 are mentioned to be inserted in each guy wire, so that the mast will have great flexibility and resilience, mechanically considered. The guy wires are, of course, highly insulated, as becomes evident in view of the fact that they form a part of the antenna proper.

Loud Speaking Telephone Receiver.

(No. 1,152,536; issued to Albert S. Moffatt.)



The patentee of this new loud-talking telephone receiver arranges an electro-magnetic circuit in the shell of same, as perceived. The diaphragm 5 is resiliently mounted and is actuated so as to reproduce sounds by means of a lever 25, connected to the soft iron armature 24. The position of the fulcrum lever 22 may be adjusted, and it is thus seen that owing to the difference in leverage thus obtainable that it is possible to greatly amplify the movement of the armature 24. Thus it is possible to make a satisfactory electro-magnetic telephonic reproducer. Also the pole 14, of the electro-magnet 21, is adjustable as to its position, as will be observed.

Electric Pilot and Night Lamp.

(No. 1,147,949; issued to Eliot Keen.)

Fig 1

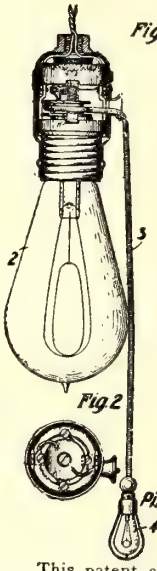


Fig 3



Fig 4



Fig 5



Fig 2

Fig 6



This patent covers a special form of pull socket in which the pull cord is arranged to comprise a flexible double conductor. To the end of this twin flexible pull cord is attached in a protective casing or cage a small pilot lamp 4. Either the large regular lamp 2, or the small pilot or night lamp 4, may be switched on by alternating pulls on the cord 3.

Electric Sad Iron.

(No. 1,148,627; issued to Edward E. Rose.)

New style of electric sad iron, providing a very neat and efficient

Fig 1

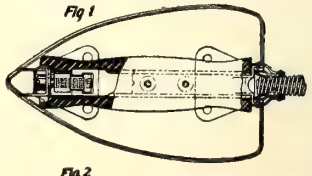
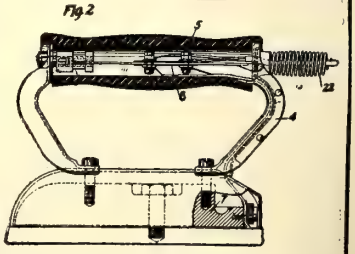


Fig 2



arrangement for leading in the double conductor cord. The double conductor cord passes through a protective spring 22, adjacent to the insulating handle 5. A connection block 6 is placed within the hollow handle and two lead wires run down through the hollow handle frame 4, to the heating element 7.

COPIES OF ANY OF THE ABOVE PATENTS SUPPLIED AT 10c. EACH.

Phoney Patents

Under this heading we will publish hereafter electrical or mechanical ideas which our clever inventors, for reasons best known to themselves, have as yet not patented. We furthermore announce the grand opening of the

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PHONEY PATENT OFFIZZ

U. R. WRIGHT OF WHEREATIN VA.

No. Umsteen hundred and forty 'leven. **BOOKWORM'S NURSE** **Pat. applied for 10 minutes 'fore lunch.**

Specification of Phoney Patent—Application Sandpapered September the Tooth

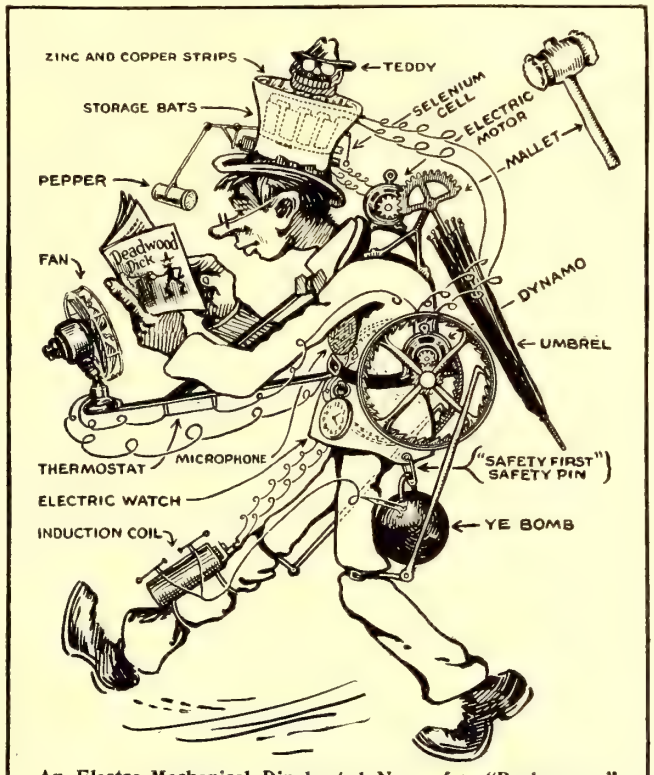
To those who—consarn it all, here goes:

I, U. R. Wright, of the Burg of Whereatin, Va., do hereby swear dreadfully, and affirm firmly that I have invented means whereby and by which a confirmed Bookworm may be relieved of all anxiety about reading too late at night, getting wet in the rain, getting overheated or run over by vehicles.

Full description of this wonderful apparatus follows:

A small but powerful dynamo is strapped to the small of the back. On each end of the shaft is an aluminum flywheel covered with fly-paper and having teeth around the inner edge of the rim. Pawls fastened to the legs of the wearer engage these teeth and spin the dynamo when the victim walks along either fro or to, hither or thither. The current thus generated is led by small wires to storage batteries concealed in the high stove-pipe hat which goes with the outfit. So a man, thus fitted out, really has "*bats* in his belfry." The top of this hat is the most ingenious part of the whole mechanism. It consists first of a shallow hard rubber pan, shaped much like a friction tight molasses bucket lid. In this lid are laid narrow strips alternately of copper and zinc, these being connected in parallel. On top of this is an image of Theodore Roosevelt, rampant, carved from a lump of copper sulphate or bluestone. More about this later.

Between the shoulders of the unfortunate is an umbrella which normally hangs down, closed, behind him. On the handle end of the umbrella is a segment of gears which engage with a small motor. Now the action is thus: When a shower starts, and the Bookworm is ambling along, face buried in a volume of "Deadwood Dick," the rain drops trickle over the Bluestone image of "Teddy," partly dissolving him and covering the zinc and copper strips with bluestone solution, thus forming an electric cell. (The bluestone image, after months of constant use, will acquire a likeness to William Jennings Bryan.) The electric current thus set up actuates a switch which cuts in the storage battery to the motor which hoists the umbrella. There is a tiny hole in the bottom of the hard rubber lid or pan which contains the zinc and copper strips so that the bluestone solution trickles very slowly out, and down the back of the wearer's neck. For this reason the patient must wear blue acid proof overalls. When all of the solution has run out, the switch is released and the umbrella is automatically let down to its normal position.



An Electro-Mechanical Dingbusted Nurse for "Bookworms."

Strapped to the chest (if he has one) of the victim is a small electric fan in circuit with a thermostat so when it is warm the thermostat starts up a delightful mountain breeze.

Reading so much a man is likely to forget to wind his watch, so an electric watch is provided. Injury to the eyes by reading in too dim a light is prevented by a selenium cell, which in dim light releases a switch operating an electro-magnet which pulls a lever to and fro rapidly, on the end of which is a pepper shaker. This shakes pepper in the eyes of the reader and thus calls a halt.

While crossing the street, interested in a book, one pays no attention to approaching autos and cars. A sensitive microphone worn on the person actuates a spark, which explodes a bomb under the coat tails of the bookworm, hefting him gently into the air, while the said vehicle saunters nonchalantly on beneath him upon its wonted way.

To prevent reading in bed too late at night, a 10-pound mallet is fastened in the umbrella socket, and at the appointed time the electric watch connects the circuit and the mallet descends upon the noodle of the victim, giving 40 swift swats, knocking him insensible till morning, when he is awakened by a shock of 10,000 volts from an induction coil.

In testimony whereof, I have hereunto appended my nom-de-feather this day, O Lord, preserve us from further attacks.

U. R. Wright.

By his attorney,

Stanley H. Covington,
Lynchburg, Va.

Witnesses: I. B. Darn, Whooda Thoughtit, Ischga Bibble.

INVENTION TO DETECT PRESENCE OF OTHER BOATS.

W. Lorenz, a jeweler of Buffalo, N. Y., has succeeded in perfecting two valuable instruments which have been accepted by the Canadian navy. One of the inventions is known as a "ship detector" on which he has been working two years.

The detector makes it possible for a ship properly equipped to ascertain whether other boats are within a certain distance, their direction and approximate location. The instrument works on the principle of wireless telegraphy. The vibrations of a ship being detected are communicated to the receiving apparatus through the vibrations caused by the machinery. The apparatus will work effectively, it is said, regardless of the number of ships within its operating radius. The other invention has not been made public.

NEW WIRELESS STATION AT CHELSEA, MASS.

On Sept. 15 the new wireless station at the Naval Hospital, Chelsea, was opened. It will be the most powerful on the Atlantic coast. The station at the navy yard will not be dispensed with, but will be run just the same. The new station cost in the vicinity of $125,000.

WIRELESS SYSTEM SAVES 500,000 LIVES IN A YEAR.

Fresh evidence of the value of the wireless as a saver of lives has been found during the disasters and threats of disasters following in the wake of the European war.

Repeatedly the Atlantic Ocean has been combed by wireless in its sending of warnings to threatened passenger ships. Although no figures are at hand, a wireless operator has just estimated that not fewer than 500,000 lives that would have been lost before the invention of the Marconi system have been saved by it since the beginning of the present year.

QUESTION BOX

This department is for the sole benefit of the electrical experimenter. Questions will be answered here for the benefit of all, but only matter of sufficient interest will be published. Rules under which questions will be answered:

1. Only three questions can be submitted to be answered.
2. Only one side of sheet to be written on; matter must be typewritten or else written in ink, no penciled matter considered.
3. Sketches, diagrams, etc., must be on separate sheets. Questions addressed to this department cannot be answered by mail.

MEASUREMENT OF FREQUENCY IN A. C. CIRCUITS.

(345) F. Callahan, ————, wants to know how the frequency of an alternating-current circuit may be measured.

A. 1. There are several ways of measuring the frequency in cycles of alternating-current circuits, but the usual and most direct method is that utilizing a standard "frequency meter" of the direct-indicating type. One of these, of the vibrating-reed type, costs about $65 for frequency measurements somewhat above and below 60 cycles.

FREAK RADIO RECEPTOR.

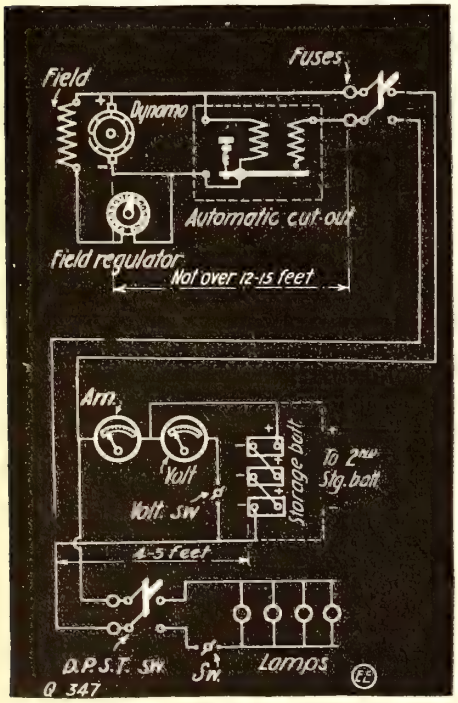
(346) J. M. Butcher, Medina, O., explains how he has picked up radio signals on a telegraph sounder without any detector.

A. 1. In most cases that have come to our attention and along the line you mention is has been found that the armature bar, etc. (of the telegraph sounder, for instance), has been so adjusted that it formed a *microphonic* contact which would pick up wireless signals; or also it would act as a reproducer of speech under certain conditions.

Quite possibly the dead wire circuit running from the sounder acts as an aerial, and wireless signals have been repeatedly picked up by using a telegraph or telephone circuit as an antenna.

BATTERY CHARGING CUT-OUT.

(347) L. J. Roche, Lafayette, N. Y., inquires about making a battery charging



Wiring Diagram for Storage Battery Lighting Plants.

cut-out for accumulator plants.

A. 1. The appended lighting plant diagram shows how the E. I. Co. automatic storage battery charging cut-out works.

You may experiment with this form of cut-out, and in designing the coil windings you should allow about 1,000 circular mils area of copper wire for each ampere which is to pass through the coils. Hence you can very easily design the coils by referring to a standard B. & S. wire gauge, as given in most electrical catalogs.

While one size of cut-out with certain windings on same will take care of a dynamo and battery outfit somewhat higher or lower in voltage than that which it is designed for, it becomes necessary to rewind the coils especially for the dynamo to be used when the dynamo varies 20 to 25 per cent. above or below the rating of the cut-out.

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If you have anything to buy, sell or exchange and want to make sure of doing it quickly and at an insignificant cost, advertise in the

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The Classified Columns of the ELECTRICAL EXPERIMENTER GET RESULTS

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THE TUCKERTON, N. J., RADIO STATION.

(348) James S. ————, Washington, D. C., asks what form of high-frequency generator is employed at the Tuckerton, N. J., trans-oceanic wireless station operated by the Goldschmidt interests.

A. 1. The powerful radio station at Tuckerton, N. J., uses a Poulsen arc oscillation generator of about 60 k.w. rating.

Data on this and other powerful stations in this country is given in the Government "Radio Call Book," procurable at 15 cents from the Superintendent of Documents, Washington, D. C.

LOADING COILS.

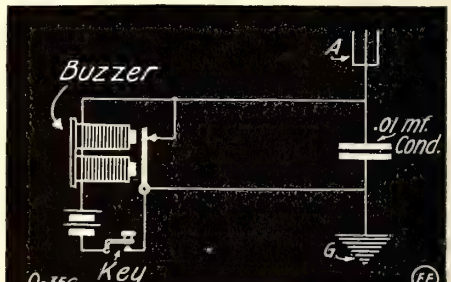
(349.) R. A. de Vore, Atlanta, Ga., wants to know the number of turns necessary on tuning coils 3 inches in diameter to obtain the longest possible wave length with an aerial 300 feet long and 50 feet high. He also wishes to know the maximum additional wave length he can receive by using a loading coil.

A. 1. There is, generally speaking, no limit to the wave length you can receive by using large coils; that is, you can wind a coil 10 feet long, but such large coils are not properly proportioned. A properly constructed tuner has a length that is equal to about four times its diameter. A coil of this size, 12 inches long and 3 inches in diameter, wound with No. 24 wire, in connection with your aerial should have a wave length of about 2,500 meters, and you can add loading inductance both in the aerial circuit and the detector circuit to raise this wave length up to 7,000 or even 10,000 meters by using coils large enough. The usual practise is to put a condenser across the secondary circuit to increase its wave length.

CONDENSERS AND RANGES.

(350.) A. Paul Peck, Plainfield, N. J., asks several questions: 1. Whether glass plates can be used in receiving condensers. 2. The wave length of his aerial. 3. The distance over which he can receive with his apparatus. 4. How far he can transmit with a buzzer outfit.

A. 1. Glass plates can be used for receiving condensers and are suitable for such purposes, but their disadvantage is that they are rather bulky; otherwise they are superior to those made from paraffine paper.



Buzzer Used for Transmitting Radio Signals.

A. 2. The wave length of your aerial, 80 feet long, 20 feet high, with lead-in 15 feet long and a ground wire 20 feet long, would be approximately 160 meters.

A. 3. We do not make a practise of answering questions regarding the range over which wireless sets will receive, be-

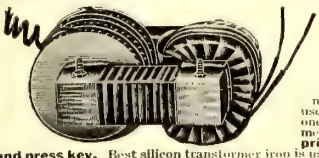
(*Continued on page* 354.)

EXPERIMENTERS READ EVERY LINE OF THIS INTERESTING AD-

We've prepared it with care and it's written for *YOU*. We want you to *know* the Electro-Set Co. We are anxious to have you *realize* what we are doing to make experimenting financially possible for every live American Boy. We haven't space to tell you all—you'll have to send for our catalogues to see this. We are taking this opportunity to introduce only seven of our regular specialties and 14 wonderful bargains in odd parts such as every experimenter needs and can use. One order will convince you what the Electro-Set Co. is offering. Get in touch with us *to-day*.

HERE IT IS AT LAST!

This 1-6 K. W. Closed Core Wireless Transformer..... **$6.95**



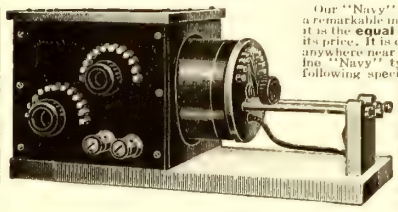
After months of experimenting and after making dozens of designs and models, we have finally produced a thoroughly practical closed core transformer to retail at $6.95, the price you formerly had to pay for spark coils and batteries.

Thousands of amateurs will welcome the advent of this instrument who either did not require ¼ K. W. power or who did not care to spend the money for it. The transformer will send messages for twenty miles not a wild figure, but an actual fact—if a good aerial is used. **Under extraordinary circumstances it will send** one hundred miles. No trouble with vibrators and adjustments, reactances or resistances. **Just connect the primary terminals to 110 volt, 60 cycle A.C. mains and press key.** Best silicon transformer iron is used in its construction.

It will throw a heavy crashing spark that, with proper condenser, will fill a gap with a ball of white flame ½ inch in diameter. This comparatively small but powerful spark will send **six times as far as a 1 inch spark coil.** The 1-6 K. W. Transformer is another **ELECTRO-SET triumph.** It was thoroughly tested in one of the most complete electrical laboratories in the country by competent engineers, who pronounced it perfect, for its size, in all particulars. You will be delighted with it.

No. 1000 1-6 K. W. CLOSED CORE TRANSFORMER, without case, shipping weight 10 lbs. . . **$6.95**
No. 1001 1-6 K. W. CLOSED CORE TRANSFORMER, in a beautifully finished mahogany case; impregnated with insulating compound and fitted with four posts; shipping weight 15 lbs. . **9.00**

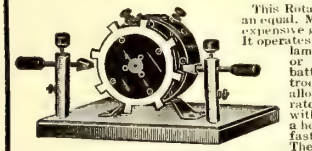
Electro-Set "Navy" Loose Coupler



Our "Navy" Loose Coupler or Receiving Transformer is a remarkable instrument. In price it is **lower** and in quality it is the **equal** of almost any loose coupler, no matter what its price. It is certainly far superior to any we have seen at anywhere near its price. Think of being able to buy a genuine "Navy" type loose coupler at a low price with the following specifications usually only found in prohibitively priced transformers: Hard rubber secondary end with large turned brass contacts; hard rubber switch panel on the front of the primary coil with twenty large, turned brass contacts; primary enclosed in a dark mahogany finished covering on all sides; every contact soldered, assuring perfect connection; handsome mahogany finished base; lacquered brass posts and trimmings. The equal of this receiving transformer can not be found. It is the acme of efficiency at moderate price.

NO. 1698 "NAVY" RECEIVING LOOSE COUPLER; shipping weight 10 lbs. **$10.00**
NO. 1698 "NAVY" RECEIVING COUPLER; all wood construction. **9.00**

Type "A"



This Rotary Spark Gap is without an equal. Made like any of the more expensive gaps, but smaller in size. It operates in series with a 16 C. P. lamp on 110 volt alternating or direct current or from batteries. The Rotary Electrode is of cast aluminum alloy and is perfectly accurate. The wheel is mounted with genuine hard rubber on a heavy brass bushing which fastens to the motor shaft. The motor is a K. & D. series wound A. C. or D. C. Machine, small but **powerful.**

This Type "A" Gap, although especially designed for our extraordinary 1-6 K. W. transformer will readily stand any good ¼ K. W. instrument.

NO. 476 TYPE "A" ROTARY GAP, shipping weight 4 lbs. . . **$5.50**
NO. 477 TYPE "A" ROTARY GAP, wound to operate on 3 dry cells. **5.00**
NO. 478 THREE INCH ROTARY DISC ONLY, mounted on hard rubber, with brass bushing, ⅛ in. bole, shipping weight 4 oz. **1.50**

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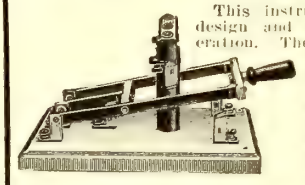
Send 6c. in stamps for our SPECIAL ELECTRIC TRAIN CATALOGUE, illustrating scores of models. Send 4c. in stamps for our Electric Vibrator and Medical Coil Catalogue.

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MARCONI USED APPARATUS

Send 5c. in stamps for new, interesting catalogue of used Marconi Wireless Instruments at ridiculously low prices. We are agents for this line and can ship promptly anything from a Type "D" Tuner to a Motor Generator.

No. 611 Aerial Switch



This instrument is novel in design and convenient in operation. The base is dark mahogany finished. The copper bars are 8 inches long and are sawed, not drawn. Posts are provided on all contact jaws for connections. Three posts and bars are provided on one side for the purpose either of shunting the detectors when sending or cutting off the transmitting power when receiving.

This instrument is handsome in appearance and efficient in use. Suitable for powers up to 1 K.W.

NO. 611 AERIAL SWITCH,
Shipping weight 5 lbs. **$2.50.**

Electro-Set "Arlington-Tested" Crystals

When testing out a wireless receiving installation for the first time you want to know that your mineral crystal is sensitive. Then, too, why buy minerals on a gamble. **Be sure of results—good results.** Buy our **"Arlington Tested"** Crystals. Every one is tested for Arlington time signals. Each crystal comes sealed in an air-tight glass phial and is carefully tested before leaving our factory. **Only one crystal in 20 passes our examination.** Arlington Tested Crystals are the most sensitive you can procure. They are worth the price. Each one is individually examined and packed.

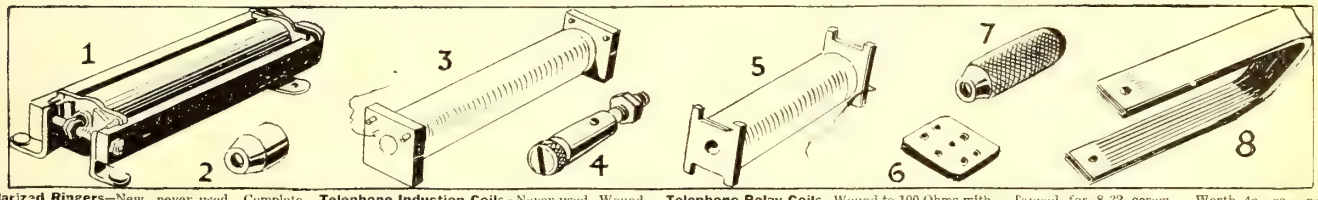
NO. 301 ARLINGTON TESTED GALENA, individually packed and tested; postpaid . . **$0.15**
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NO. 303 ARLINGTON TESTED BORNITE-ZINCITE COUPLE . . . . . **.40**

Electro-Set "Famous" Mineral Sets

One of the most interesting fields in wireless telegraphy is the experimenting with various combinations and methods of contact in detectors. We offer the following outfit especially designed for this purpose and packed in a neat box. Countless hours of interesting experimenting is offered to the amateur with this set. It includes five different minerals (galena, silicon, carborundum, bornite and molybdenum), each packed in a neat glass bottle; one universal detector cup; three pieces phosphor-bronze "cat whisker" wire; one polished wood detector base; one large binding post; one hard rubber knob; one brass rod with holder for wire. With this outfit it is possible to make many different kinds of detectors. It is ideal for the experimenter.

NO. 2100 DETECTOR MINERAL SET, as described, complete, postage paid. . . **$1.25**
NO. 2150 MINERALS ONLY, as above, five kinds, in bottles, postage paid. . . . . **.50**

14 EXTRA-ORDINARY BARGAINS



Polarized Ringers—New, never used. Complete with 2 high resistance magnet coils wound with silk wire and a strong permanent magnet with ringer. Worth 60c. ea. Any experimenter can use one. Special price, ea. **15c.** (Postage 6c.)

Hard Rubber Knobs—Size 19-16 in. x ½ in. Drilled and Tapped for 6-32 screw. Handy for making apparatus. Worth 3c. ea., new. Special Price, per doz. **10c.** (Postage 3c.)

Telephone Induction Coils—Never used. Wound to 100 Ohms with primary and secondary coils, silk covered wire. Excellent shocking coil can be made with one. Worth 50c. ea. Special price ea. **09c.** (Postage 4c.)

Binding Posts—Handsomely nickeled, 5-16 in. x 1 in. over all. Complete with nut. Worth 6c. ea. Special price, per doz. **25c.** ea. **2½c.,** (Postage per doz. 6c.)

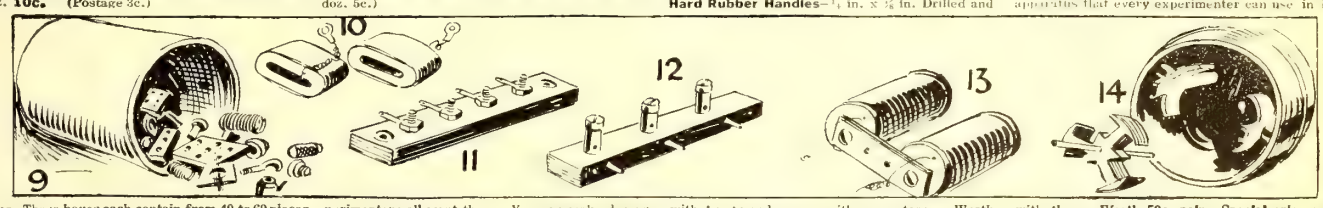
Telephone Relay Coils—Wound to 100 Ohms with size 36 silk covered wire. Complete with soft iron core. Wire alone worth 20c. Special price, ea. **09c.** (Postage 4c.)

Connecting Blocks—Hard rubber, size ¾ in. x 1 in. x 3-16 in. Have 6 holes for 6-32 mach. screws. Complete with 6 screws. Worth 12c. ea. Special price **04c.** (Postage 1c.)

Hard Rubber Handles—4 in. x ⅝ in. Drilled and tapped for 8-32 screw. Worth 4c. ea., new. Special price, per doz. **15c.** (Postage 3c.)

Horse Shoe Magnet—3 in. long, very powerful—useful for many experiments and for making instruments. Worth 15c. each. Special price **05c.** (Postage 3c.)

Here's A Dandy Chance—We have made up a number of boxes of small odd parts of electrical apparatus that every experimenter can use in his



shop. These boxes each contain from 40 to 60 pieces of odds and ends, such as rubber knobs, brass standards, hooks, binding posts, screws, units, thumb nuts, coils and miscellaneous parts. Some are new—some used, but all of them are useful to have around when you are making apparatus. They are just the kind of convenient parts to be able to choose from for your experiments. We've sold hundreds of them in our retail department. Experimenters all want them. You can make dozens of things with them.

No. 121—Handy Assortment. Prepaid **20c.**

75 Ohm Receiver Coils—Never used. Ready to put into any phone or to make receivers with. Wound to 75 ohms with silk wire. Worth 20c. pair. Special price, per pair, with connectors **06c.** (Postage 1c.)

Connecting Blocks—Made of genuine hard rubber, with 4 nuts and screws with connectors. Worth 15c. ea. Special price, ea. **05c.** (Postage 2c.)

Connecting Blocks made of genuine hard rubber with 3 handsome nickeled binding posts. Useful for dozens of things about the experimenter's shop. Worth 25c. They have never been used. Special price, ea. **09c.** (Postage 2c.)

Relay or Telegraph Magnets—In fair condition. Have been used but are in perfect shape. Wound to 80 ohms resistance. Make relay or telegraph with them. Worth 50c. pair. Special price with yoke, per pair **09c.** (Postage 5c.

Toy Motor Parts—Consisting of one iron case with pole pieces, 2 covers for same and one 3-pole laminated armature with shaft. All you need is a commutator, bearings, and wire to complete motor. Above parts worth 40c. set. Special price, **15c.** (Postage 6c.)

Note:—Commutator wire for above motor, extra **40c.** (Prepaid.)

THE ELECTRO-SET CO. 1874 EAST 6th ST., Dept. 110 CLEVELAND, OHIO

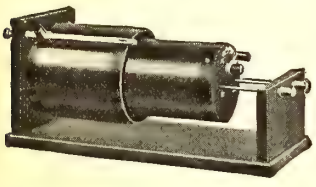
YOUR RANGE
DEPENDS ON YOUR
RECEIVERS





Holtzer-Cabot
Radio Receivers
have honestly earned their reputation of being the
"Most Sensitive Receivers Made"
Other features are light weight, comfortable shape, durability, perfect finish. Send for Booklet 20 D2 for description.
THE HOLTZER-CABOT ELECTRIC CO.
BOSTON — CHICAGO

LOOK! A NEW CHAMBERS COUPLER No. 744, PRICE ONLY $6.00



Positively unequaled for the money. Is 6" high, 6" wide, and 14" over all. Wound with Enameled wire, and has a very unique slider. Woodwork mahogany finished. Try one, you will not be disappointed.

5c. in stamps brings our 64-page illustrated catalogue, B-B-24. None otherwise.

F. B. Chambers & Co. 2046 Arch Street Philadelphia, Pa.



"Mignon-System"
Patents Applied for
R C 2
$20.00
A Marvel in Selectivity and Efficiency.
The Last Word in RADIO-APPARATUS.
Write for Literature
SIZE 12½ x 9½ x 6 INCHES
MIGNON-WIRELESS CORPORATION
Specialists in Radio Signal Receiving Apparatus
127 W. Market St., ELMIRA, N. Y.

NEW SAYVILLE PHOTO
SHOWING THE ELEVEN NEWLY COMPLETED MASTS
(3 of them 500 feet high). Also two detail inserts, showing buildings, etc.—3 in 1—Size 6x8 in. Mailed in roll, ready for mounting 25c. postpaid. Send stamps. Ask for free wireless catalog.
CHRIS. M. BOWMAN
Box 104 LANCASTER, PA.

cause there are so many factors governing this. It is impossible to make more than a haphazard guess.

A. 4. The buzzer transmitter set illustrated will transmit about half a mile under ordinary conditions, but distances as high as five miles have been covered with same. A prominent New York firm is about to market a buzzer which they claim will cover distances of about 100 miles.

AERIAL AND GROUND.

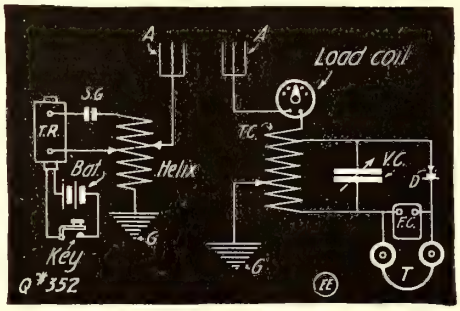
(351.) Wallace Green, Hackensack, N. J., asks: 1. The effect of the height of an aerial above sea level. 2. The effect of grounding wireless apparatus and a telephone on the same water pipe.

A. 1. The height of an aerial above sea level will have a tendency to increase your range, but not in direct proportion, as it is the height above the ground which determines to a great extent the range. This is due to the fact that waves propagated into the ether have a tendency to follow the surface of the ground and not to continue in the same plane as the station from which they are emitted.

A. 2. The effect of grounding wireless apparatus and the telephone on the same water pipe will not be noticed unless the 'phone wires run very close to the aerial. In that case a large part of the energy from the transmitting set will be absorbed by the wires and will cause annoying noises in the receiver when using the 'phone.

RADIO QUERIES.

(352.) W. B. Jones, Hampton, Va., asks: 1. For a hook-up for a transmitting apparatus and receiving apparatus. 2. If he



Radio Transmitting and Receiving Hook-ups.

can pick up Sayville and other such stations. 3. The standing of the Dodge Institute of Telegraphy and Radio.

A. 1. Attached drawing shows the method of wiring transmitting outfit, using quenched gap, ¼-inch spark coil. Hook-up for your receiving outfit is also shown.

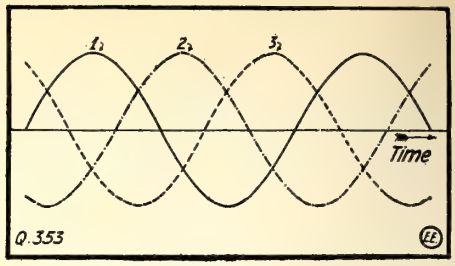
A. 2. We cannot say positively if you can receive Sayville or not, but would advise you to listen for signals when the station sends press, which is between 8 and 11 p. m.

A. 3. We are assured that the Dodge Institute of Telegraphy has the best that can be obtained in equipment, and its faculty consists of experts in the line they are teaching.

A. C. MOTORS.

(353.) Earl Meldrim, Fort Edwards, N. Y., inquires the difference between one, two and three-phase motors, and which are the best to use.

A. 1. One-phase motors operate on an alternating current circuit that posseses but one wave; that is, it reverses at stated periods. The two-phase circuits generally consist of four wires, and the phases are 180 degrees apart; that is, the current in one set of wires is at maximum when the other is at minimum. The three-phase current consists of three waves combined on three



Three-Phase Alternating Current Waves.

wires, and the peaks of the currents are 120 degrees apart; this will be understood from the drawing. It gives a sketch of the current waves in a three-phase circuit. As to the best motor to use, it depends on the purpose to which the motor is being put. A three-phase motor has been found to be very practical, but requires quite an elaborate starting system; it has a good starting torque. This motor is what is known as the induction type; that is, the fields and the armature have no electrical connection. The two-phase motors operate on the same principle, but the windings are wound in two separate coils, not connected. The single-phase motor is generally of the synchronous type; that is, it starts as a series-wound direct-current motor, but on reaching synchronism with the supply current the connections to the armature are automatically cut out and the motor operates in synchronism with the alternating current supplying same.

HORSEPOWER QUERY.

(354.) Felix Washakas, Chicago, Ill., desires to know the horsepower of a motor required to move 100 pounds at a rate of 1,320 feet per minute on a level surface, and the amount of current it will take to run the motor.

A. 1. As you do not give any clue to the coefficient of friction in your letter, we have figured out the required power of if the weight was being lifted vertically. It would require a 4-horsepower motor to move 110 pounds the required number of feet per minute in a vertical direction, but if the weight is mounted on wheels or rollers the power required will drop to about 10 per cent. of this amount. It will require 28 amperes at 110 volts to run the 4-horsepower motor, and if the power is to be applied horizontally the amperage will drop to 2.8 approximately, and the horsepower to .4.

AERIALS AND RANGES.

(355.) Edward Jones, Fairmont, W. Va., asks several questions: 1. The efficiency of the spiral aerial as compared to that of the straightaway. 2. The wave length of a spiral aerial 14 inches in diameter, 60 feet long, which contains 800 feet of Antenium wire. 3. What is the time of operation of the Sayville station. 4. What high-power stations should he be able to receive from. 5. The advantage of a large capacity variable condenser.

A. 1. We have had no experience with a spiral aerial. From reports, we believe it to be very efficient, but for all-round amateur work we advise the construction of a straightaway aerial, as it has given great satisfaction in the past.

A. 2. The wave length of the spiral aerial containing 800 feet of wire will be between 1,200 and 1,400 meters.

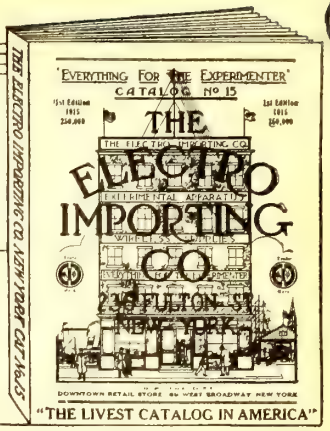
A. 3. Sayville is still in operation, but is under U. S. Government control. It sends press every evening from 8 to 11.

A. 4. You should be able to hear the N. A. I. and W. H. E. Marconi stations at

(*Continued on page* 356.)



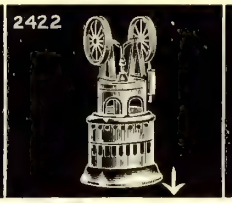
"EVERYTHING FOR THE EXPERIMENTER" IN THIS "THE LIVEST CATALOG IN AMERICA"



THE ELECTRO IMPORTING COMPANY CARRIES THE LARGEST STOCK OF EXPERIMENTAL, ELECTRICAL AND WIRELESS GOODS IN THE WORLD. *We are the originators of the Wireless Experimental business in the U. S.*, selling the first wireless outfit in 1904. Our wonderful facilities enable us to give you *delivery in 24 hours.* WHEN ORDERING GOODS FROM THIS PAGE ENCLOSE POSTAGE ELSE GOODS MUST BE SHIPPED BY EXPRESS COLLECT. The goods shown here are only a small part of our entire line which is fully described in our 275-page Cyclopedia Catalog, which weighs ½ lb., is 6¾x5¼ inches in size and contains 2,000 articles, 658 illustrations, 30 diagrams and tables, full Morse Continental and Navy Code Charts, besides "Treatise on Wireless Telegraphy," list of call letters of all U. S. Gov't and Commercial ship and shore stations. This wonderful Cyclopedia sent free if you send us 4c. in stamps or coin *to cover postage only.* WE SELL MERCHANDISE, NOT CATALOGS. *"Why buy Catalogs when the best is free?"* Use coupon below to send for Catalog, enclosing 4c. for postage only.



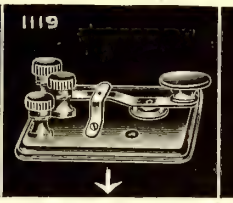
Boy Scout Knife. Has 2 excellent quality steel blades, stag handle and a chain to guard against loss. Chain is detachable at will. Length 3⅜ in. Sh. wt. 4 ounces. Price ..... **$.50**



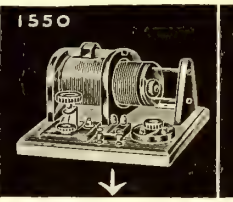
Upright Caloric Engine. Runs by hot air. Simplest model engine possible to construct. Is very durable. No steam or water used. Size 9⅓x4½. All cylinders of brass. Sh. wt. 2 lbs. Price..... **$.95**



Smallest Flashlight Made. Nickel case, tungsten lamp, long life battery. Gives a very powerful light, is very handy and fits in vest pocket. Size 2½x1¼x11-16. Sh. wt. 4 ounces. Price ..... **$.50**



Telegraph Key. Double circuit. Rubber comp. base and knob. Has three rubber comp. binding posts. Metal parts nickeled. Size 2½x3½. A wonderful value. Sh. wt. 1 pound. Price ..... **$.35**



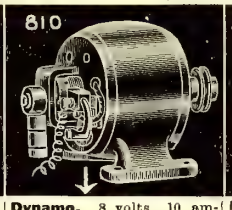
Inter-Ocean Wireless Receiving Outfit. Has loose coupler, galena detector, Jr. fixed condenser and 7000 meter loading coil all mounted and connected on polished oak base. Size 10x12x 6½. Sh. wt. 10 lbs. Price **$8.00**



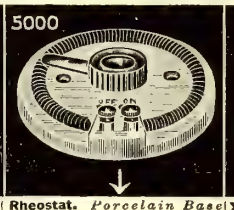
Wireless Detector. *Guaranteed to receive long distance messages or money back.* Base hard rubber comp. Metal parts nickeled. galena crystal supplied. Size 2x 1½x1¼. *Our cyclopedia sent free with it. Price prepaid* ..... **$.10**



Rugby Football. Made of Pebble grain leather, lined with duck. *Bladder guaranteed against accident, wear or abuse for one year.* Most wonderful value ever offered. Standard size. Sh. wt. 2 lbs **$.90**



Dynamo. 8 volts, 10 amperes. Very heavily built for auto. ltg., charging batteries, electroplating, etc. Excellent power motor on 8 volts, made to last. Size 8x5½x5¼. Sh. wt. 20 lbs. Price **$9.00**



Rheostat. *Porcelain Base* (Pat'd). Resistance 10 ohms, maximum capacity 3 amps. continually. Invaluable for dimming lamps, regulating small motors, etc. Diameter 4 inches. Controlled by 1" knob. Disconnects on off side. Binding posts rubber comp. Sh.wt. 2 lbs. Price ..... **$.60**



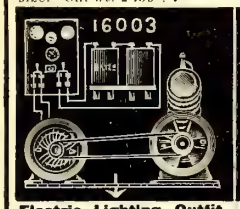
X-mas Tree Lighting Outfit. For 110 volt house current. Has 16 colored lamps, red, blue, white and green, arranged in two festoons. Absolutely safe and complete with cord and plug. Sh.wt. 3 lbs. Price.. **$4.05**



Hustler Motor. Runs wonderfully on one dry cell. Will operate small toys, beautifully finished and very strong. A wonder for the price. Size 3x3x4. Sh. wt. 1 pound. Price ..... **$.85**



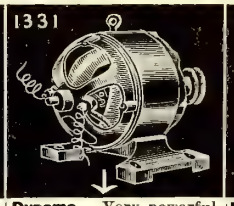
Revolver Flashlight. Exact model of automatic revolver, shoots brilliant light when trigger is pressed. Contains tungsten lamp and battery in handle. Surprise your friends. Size 4x2¾ ins. Sh.wt. 1 lb. Price **$.95**



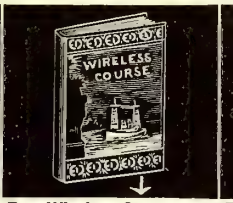
Electric Lighting Outfit. 8 volt 150 watt capacity. Includes generator, switch board with meters, etc., ¼ H. P. gasoline engine, storage battery, fuses, wire, belt, hydrometer and plans. Capacity 19 lights. Sh. wt. 185 lbs. Price... **$74.00**



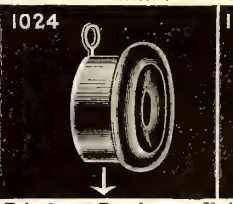
Radio Nitrogen Battery. *Gives 3 volts* and is same size as standard No. 6 dry cell. Wonderfully efficient. Made of extra high grade materials. Used for lanterns and experimental work. Size 6x 2½. Sh.wt. 3 lbs. Price **$.35**



Dynamo. Very powerful, gives 6 volts 6 amperes, lights, 12 tungsten lamps, charges storage cells, runs as a power motor, etc. *Not a toy.* Size 6x6x6 inches. Sh. wt. 7 pounds. Price **$3.70**



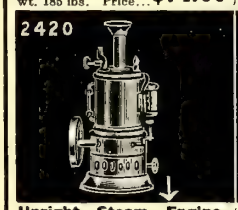
Free Wireless Course consisting of 20 lessons, total 160 page, cloth binder size 7x10¼ in. with 350 illus. 30 tables. *Coupons for this Free Wireless Course in our Cyclopedia Catalog.*



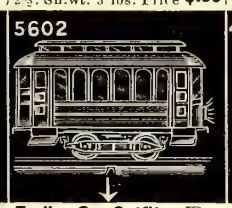
Telephone Receiver. 75 ohms. Hard rubber comp. powerful magnet. With two receivers and no battery, you can talk 500 feet. Size 2¼ x 1¼ inches. Shipping weight 1 pound. Price ..... **$.40**



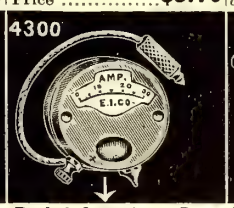
"Presto" Hand Lamp. Fits on any dry cell and will burn for 50-75 hours. No danger and always ready. Supplied complete without battery. Reflector is adjustable. Size 6x3. Sh.wt. ⅞ lbs. Price **$.75**



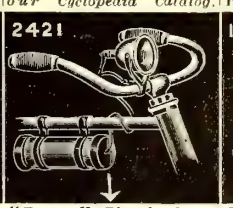
Upright Steam Engine. Has water gauge, whistle, large balance wheel and will operate on kerosene and petroleum. Tested before shipment. Directions included. 11 in. High. Sh.wt. 3 lbs. Price..... **$.95**



Trolley Car Outfit. Wonderful value, will run on dry cells. Outfit consists of trolley car, controller, electric headlight and 15½ feet of straight and curved track. Car size 12x6x4. Sh. wt. 10 lbs. Price.... **$5.65**



Pocket Ammeter. Range 0-30 amperes. Pocket size. Finely nickel plated, accurate, dependable and handy. Invaluable for testing dry cells. Diameter 2¼ inches. Net weight 4½ oz. Sh.wt. 1 lb. Price... **$.80**



"Presto" Bicycle Lamp (electric). Operates almost *50 hours on one dry cell.* 2 inch reflector is fully adjustable. Fastens on handle bars. Battery container included but no battery. Perfectly safe. Sh.wt. 2 lbs. Price **$1.15**



Spark Coil. Gives 1 inch flaming spark on 6 volts. "Bull Dog" style that's copied but never equalled. Oak frame, platinum points. Rubber comp. binding posts. Size 7¾x5¾x6¼. Sh.wt. 6 lbs. Price **$4.00**



Printing Press (Self-Inking). Will print a form of 2½x1¾ in. Includes 5a font, of 175 characters, type case, gold and silver bronze, ink, cotton, cards, etc., with instructions. Not a toy. Size 14x 7¾x6½. Sh. wt. 25 lbs. Price..... **$3.00**

THE ELECTRO IMPORTING COMPANY

"EVERYTHING FOR THE EXPERIMENTER"

236 FULTON STREET, NEW YORK

Write your name and address in the Margin below

CRYSTALOI
THE NEW—BB—

The New Type -BB- CRYSTALOI is a SUPERSENSITIVE Detector comprising every accessory and refinement in A SINGLE UNIT

It consists of a highly finished African mahogany case in which is located a super sensitive Crystaloi cylinder of which the periphery protrudes through the top making it accessible for rotating to secure finest adjustment. A cohering inductance especially calculated and calibrated to the supersensitive cylinder. A fixed condenser with the exact capacity for this particular cylinder. A specially wound Buzzer of which the frequency is controlled by a knurled screw head mounted on the front of the case to produce a note that is best suited to assist in cohering the alloy in the cylinder. Two of the highest grade dry batteries to operate the Buzzer and a Buzzer control button which protrudes through the top of the case for accessibility.

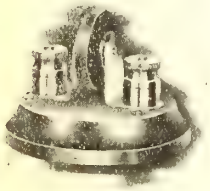
With this carefully designed and calibrated instrument you have but to set it on the table, connect your phones and leads from your tuning coil and you are permanently and thoroughly equipped to engage in the most serious wireless work of the present day. Of course Variable Condensers can be added if desired.



Dimensions 7½ x 5½ x 3½ high
Mailing Weight 3 Pounds. Price **$12.00**

— Other Types of the Crystaloi —

CRYSTALOI TYPE O
Very Sensitive



Dimensions 2¼ x 1⅞ in.
Mailing Weight 1 Pound.
PRICE, $3.50.

TWENTY-ONE HUNDRED MILES IS THE LATEST CRYSTALOI RECORD

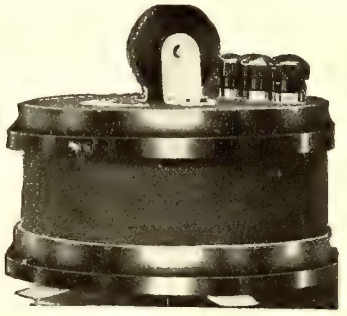
CRYSTALOI

A PERMANENT WIRELESS DETECTOR THAT HAS MADE A WONDERFUL RECORD

You will find wireless men on land and sea using Crystaloi Detectors in preference to any other detector made. They will not burn out or go dead and are ever ready to pick up the minutest currents that are in the air. They are sold under the Turney guarantee and are making their wonderful reputation on real merit. Send today for full description.

ORDER A CRYSTALOI TODAY AND STOP YOUR DETECTOR TROUBLES

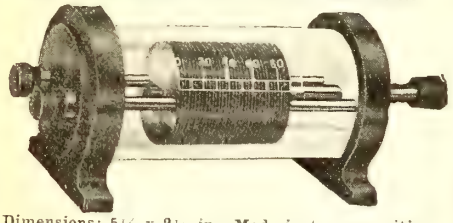
CRYSTALOI TYPE AA, Super Sensitive



Dimensions 4 x 3½ in.
Weight 2 Pounds. PRICE, $6.00.

OUR WIRELESS ACCESSORIES

THE NEW TURNEY VARIABLE CONDENSER



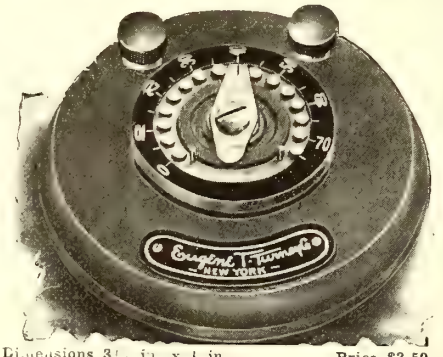
Dimensions: 5½ x 2½ in. Made in two capacities.
Type X—35 Plates. Price $3.50.
Type XX—50 Plates. Price, $5.00.
ORDER ONE NOW
and see what you have been missing.

The New Turney Variable Condenser meets all the requirements of the most exacting wireless man inasmuch as it has more capacity for its size than any condenser ever made. The great advantage lies in the fact that it is provided with round plates of a special alloy 1½ in. in diameter, of which the entire area is available for condensing purposes. This you will find in no other variable condenser.

The New Turney Variable Condenser possesses an absolute zero. This you will find in no other type of condenser. The plates are inclosed in a flint glass tube on which the scale is engraved. It is air and dust-proof and can not get out of order. The dielectric is air, therefore the efficiency is the greatest possible. The ends are of hard rubber composition and are highly finished. A handsomer and more valuable wireless instrument you never saw.

SEND FIVE CENTS IN STAMPS FOR COMPLETE CATALOG

THE TURNEY ROTARY LOADING-COIL



Dimensions 3½ in. x 1 in. Price $3.50.
Mailing Weight One Pound.

This is a radical departure from the accepted form of loading-coil for the reason that the entire coil with its switch points revolves while the switch blade remains stationary. This new form of construction makes a much neater and more compact instrument, and the rotating of the coil is a much more natural movement than turning the switch blade. It has a capacity of 4,000 meters divided into sixteen divisions of 250 meters each. When used with the ordinary loose-coupler will give a total capacity of about 4,600 meters. The entire instrument is of hard-rubber composition. The blade is of a silver alloy, which insures the maximum efficiency. The rotary coil has a knurled edge and is provided with a scale divided into sixteen equal divisions.

Eugene T. Turney Company, Inc., 2595 Third Avenue NEW YORK CITY

QUESTION DEPARTMENT.

(*Continued from page 354.*)

Philadelphia; you should also hear N. A. R., Key West, and N. A. X., Colon.

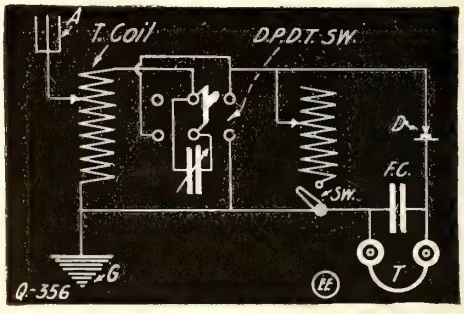
A. 5. The advantage of a large variable condenser lies in the fact that you may use large values of fixed inductances in your tuner, which means you may use fewer contacts on the switch of same and get very close tuning. A large variable condenser is generally placed across the primary of the loose coupler for long waves and switched in series with the aerial when you desire to receive short wave lengths.

MIGNON COUPLER AND DR. COHEN'S TUNER.

(356.) Reginald Pink, Bronx, N. Y., wishes to know: 1. The sizes of wire on a primary and secondary of the Mignon coupler. 2. If any of the variable condensers in Dr. Cohen's Navy set may be left out. 3. If the Wireless Association of America is still in existence.

A. 1. We are unable to supply you data upon the windings of the Mignon coupler, as this is a manufacturing secret and is not supplied to outsiders.

A. 2. We think you could use one variable condenser in Dr. Cohen's receiving hook-up by using a double-pole switch in



Wireless Receiving Tuning Diagram.

connection with it that will enable you to throw the condenser in series or in parallel with the intermediate circuit as shown in the sketch.

A. 3. The W. A. O. A. is still in existence, and you may obtain all information by writing to the Modern Publishing Co., 239 Fourth avenue, New York City.

THE TELEPHOT.

(357.) W. C. Culver, Indiana, wants to know: 1. Of what scientific value "seeing over a wire" is, or the Telephot. 2. Also a remedy for vibrator sticking.

A. 1. By the perfecting of an apparatus by which it is possible to see over a wire we would be enabled to transmit pictures with a great speed, not to mention the many industrial uses it could be put to. It will enable you to attend a moving picture show by merely going into your parlor and closing the proper switches. You would be able to sit comfortably at home and watch an automobile race 400 miles away. You no doubt know from practical experience when you are personally talking to anyone you can explain your meaning much better, as the expression of the features has quite an effect on the understanding of any information you are trying to convey; thus seeing over a wire would be, so to speak, personally interviewing a man who may be several hundred miles away.

A. 2. Regarding the trouble you are having with your vibrator sticking, would suggest that you clean the points and use a lower voltage on the coil, as it appears

to us that the vibrator has a tendency to weld the contacts together. This may be due to the condenser across the vibrator having become disconnected in some manner, thus causing undue sparking. As a rule vibrators stick due to either using too much current or not having a large enough primary condenser connected across the vibrator points.

ANTENNA QUERY.

(358.) J. Scott Wilson, Piqua, O., sends us a drawing of an aerial he intends to construct, and wishes to know the advantages of this type of aerial.

A. 1. Your aerial possesses no radically new features except the rat-tails, which are separated by means of a spreader where the lead-in is connected. This gives no distinct advantage, and we believe it will be better if you group the rat-tails 15 feet away from the aerial proper.

A SIMPLE ELECTRIC CHAIR.

(359.) D. Causey, Greenville, Ill., asks: 1. For the dimensions of a coupler, the coils to be stationary, using switches for tuning. 2. Where he can get a good tangent galvanometer. 3. If it is dangerous to operate a receiving outfit during a thunderstorm.

A. 1. The dimensions of a coupler of the type you ask about can comprise two coils 6 inches long, the larger one to be about 4 inches in diameter and the smaller to be about 3½ inches in diameter. These are wound with No. 24 and No. 28 wire respectively, and are mounted one within the other and leads brought out to the switches in the usual manner of wiring these couplers.

A. 2. You can get the address of the firm handling galvanometers from the advertising columns of *The Electrical Experimenter*.

A. 3. It is very dangerous to operate a receiving set during a thunderstorm, as the aerial acts as a lightning rod and will draw the lightning into the station, and the operator under these conditions is in danger of electrocution.

CHARGING STORAGE BATTERIES.

(360.) Raymond Johnson, Potter, Neb., wishes to know: 1. If storage batteries can be charged by gravity cells. 2. What size of wire to wind a five-bar telephone generator with to obtain 6 volts. 3. If he can make a good wireless ground by fastening the ground wire to a driven well 256 feet deep.

A. 1. Storage batteries can be charged by gravity cells, but it requires a long time for them to be fully charged. You should use sufficient gravity battery to give about 2 volts more than the storage cells for proper operation.

A. 2. By winding your magneto with No. 20 wire you will be able to get about 6 volts from same, and you can regulate the voltage by changing the speed at which you drive the machine.

A. 3. Fastening the ground wire from your wireless set to a driven well will give an ideal wireless ground, as you are making connection to moist soil.

LEAD SALTS AND THE X-RAY.

(361.) Eric C. Peters, Pennsgrove, N. J., inquires: 1. If all the lead salts have the effect of stopping X-rays. 2. Whether radium rays can pass through lead, or are reflected from it like a mirror. 3. He also asks several questions regarding the length

(*Continued on page* 359.)

Multi-Audi-Fone

The new wonder in the wireless world. It increases the Audibility 1,500 Times

Read What Others Say

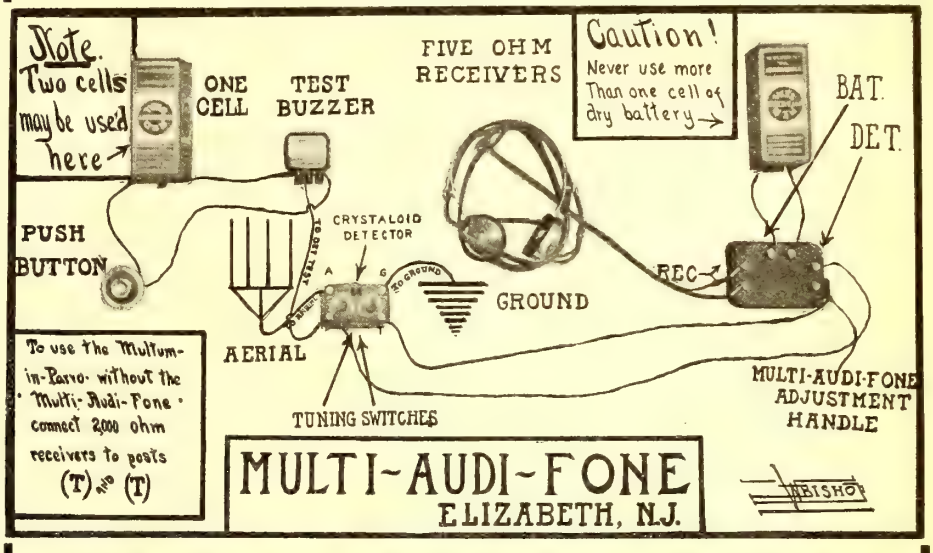
Messrs. Stickel & Stickel, of Connellsville, Pa., say: "We have given your apparatus a thorough test and find that they are all that you claim them to be."

Mr. D. L. Irvin, of Curwensville, Pa., says: "I was surprised with the results from it. Arlington and several other stations came in so loud that I could read them with the 'phones ten feet from my head."

Mr. Ralph Batcher, of Toledo, Iowa, says: "The results were even more than were expected, both at the convention and by other amateurs in Des Moines, who tested the apparatus, and other places."

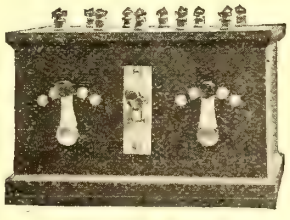
Mr. John Tucker, Jr., of Elizabeth, N. J., says: "After a thorough trial, am astonished at the results obtained . . . Combining, as these instruments do, the greatest degree of efficiency coupled with extreme compactness, they are, without doubt, the finest instruments offered to the amateur and professional wireless field at large."

W. O. Horner, of Cleveland, Tennessee, says: "I have been trying your Multi-Audi-Fone out as an Amplifier . . . I was more than surprised at its sensitiveness. It is certainly wonderful. . . . I stood at the rear of my store, one hundred and twenty-five feet from 'phones, and copied Arlington and Key West, also Tampa, Florida. I consider that some amplifying for way down here on Inland."



Multum in Parvo Receiver, including Crystaloi Detector and Buzzer - $20.00
Multi-Audi Fone, including our Specially Wound Head Set - - - - - $30.00
The Matchless Christmas Present. Our Complete Wireless Set, Only - - - $50.00

Talking Multi-Audi-Fone

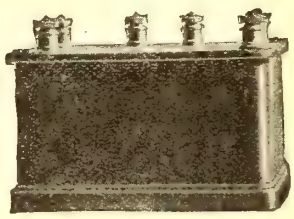


Size, 4½" x 5" x 7".

The amplification is so great with the Talking Multi-Audi-Fone that the signals can be read all over the five-story building from our laboratories, which are located on the third floor. If the windows are opened, the signals can be heard across the street, even when the trolley is passing.

Price, including horn - - - $100

Telephone Voice Multiplier



Size, 2¼" x 3¼" x 4½".

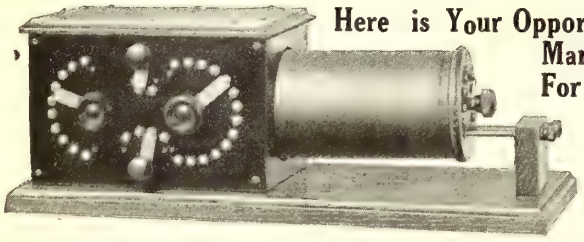
The Telephone Voice Multiplier has been made possible by applying the principle employed in our Multi-Audi-Fone to the telephone receiver. The voice can be distinctly heard coming over 1,000 or even 2,000 miles of wire that would be indistinct coming over 100 miles of wire. Buy a Multiplier and stop straining to get something you can't hear. **Price $15.00**

Send for circular to-day
Ask your dealer to-morrow
MULTI-AUDI-FONE
273 Morris Ave.
ELIZABETH, N. J.

BUY YOUR XMAS WIRELESS NOW

BIG REDUCTIONS FOR NOVEMBER ONLY

Save 25% If You Act Quickly



Here is Your Opportunity to Secure the Best Navy Type Loose Coupler on the Market. Regular Price - - - - - - $15.00
For November Only—Reduced to - - - - - - $10.00

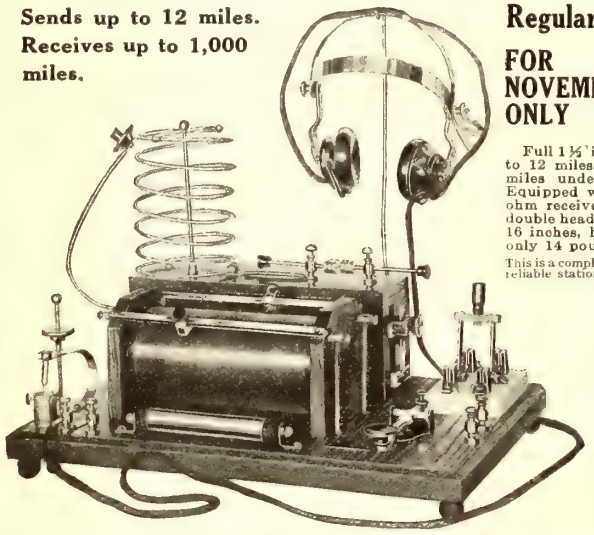
A brass lacquered 6,000 meter inductance tuner, perfect in every detail. Equipped with four point loading inductance which increases the wave length 4,000 meters over the average Navy Type Transformers. The primary winding has 24 taps—one switch controls the primary in groups of tens, the other controls one turn at a time—and is equipped with a dead end switch. Enclosed in a cabinet, the front of which is polished hard rubber. The secondary coil is wound with double silk covered wire and the inductance is varied by a ten point switch. With this coupler the very finest and most accurate tuning is easily and quickly secured. With a good sized aerial the reception of wave lengths up to 6,000 meters is possible.

All Finished Parts Ready For Assembling With Full Instructions - - - $6.50

Our No. 810 Complete Sending and Receiving Station

Sends up to 12 miles. Receives up to 1,000 miles.

Regular Price $20.00
FOR NOVEMBER ONLY $14.00

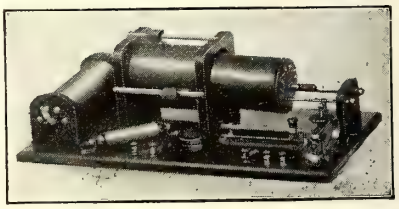


Full 1½ inch coil type. Send up to 12 miles. Receives up to 1,000 miles under favorable conditions. Equipped with 2 double pole 1,000 ohm receivers, 6 feet silk cord and double headband. Size of base 12 x 16 inches, height 13 inches, weight only 14 pounds.

This is a completely equipped and thoroughly reliable station, mechanically and electrically perfect and ready for instant service. Nothing better in this class was ever constructed. The new improved tuning coil enables you to tune in or tune out any party you might desire, thus eliminating any interference. The set consists of a 1½ in. Spark Coil, 12 Flat Plate Condensers, our "Don't Jar Out" Detector, Buzzer and Switch to tell if your detector is working, Double Slide Silk Wire Wound Tuner for long wave station capacity, Fixed Condenser, Helix, Key, DPDT Switch and complete 2,000 Ohm Headset.

Receive The Time From Arlington

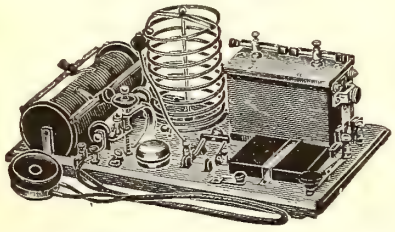
AND ALL NEWSPAPER AND SHIP REPORTS
OUR SPECIAL TIME SIGNAL RECEIVING OUTFIT REGULAR PRICE $10.85
$8.10



This is our new 1915 model made of the highest grade material obtainable. Double slide coupler for close tuning is wound with No. 24 green silk covered wire on the primary — the secondary with No. 28. There are 8 points to divide its capacity. A 3,000-metre loading coil placed between the coupler and the aerial by a switch that throws it in or out of the circuit enables you to receive amateurs with the coupler alone and long wave stations by the addition of the loading coil. One fixed condenser of proper capacity, improved universal detector, one buzzer test to test your mineral and potentiometer. This instrument is assembled on a highly finished oak base. All metal parts are heavy nickel-plated.
This station, with our Navy Type Loose Coupler, as illustrated above, ...$15.00

OUR No. 401 SENDING AND RECEIVING STATION

Regular Price - - - - $5.95
For November Only - - - - $4.95



Consists of ¼-inch coil, fluted end spark gaps, four plate secondary, one collapsible helix, one key, a two-slide tuner, fixed condenser, detector and buzzer test to test your mineral. This set is mounted on a highly finished oak base with all metal parts heavy nickel-plated. With a good-sized aerial, under favorable conditions, will send up to 3 miles and receive up to 300 miles.



FREE!

Complete Gem Station

Receives up to 300 miles. We will give absolutely free a Gem Outfit to every one who sends us the cost of the necessary equipment for it. This equipment consists of:

2000	Ohm Headset	$3.95
16	Insulators	.48
1	Ground Clamp	.10
500 Ft.	of A-1 Wire	1.20
20 Ft.	of Rubber Cable for lead in	.90
	TOTAL	$6.63

Send $6.63 at once and we will include the Gem Receiving Station Free. A splendid outfit for beginners.

Send 6c. in Stamps for Our Big 152 page Wireless and Electrical Catalog "H-80"
Containing Hundreds of Wonderful Bargains of All Kinds

Nichols Elect. Co., 1-3 W. Broadway, N. Y.

Manufacturers of Standard Quality Goods Only

QUESTION DEPARTMENT.

(*Continued from page 357.*)

of the wire used in an article on the telegraphone that appeared in the June issue of this magazine.

A. 1. It has been found that a mixture of granulated lead and linseed oil is the best lead salt to use in making garments that will protect the X-ray operator from the burning effects of the X-ray. Any cloth may be used for this purpose, but silk, being of such a fine texture, retains the salts much better.

A. 2. Lead is opaque to all the radium rays and acts as a screen, absorbing them and having very little reflecting effect. This applies likewise to X-rays, as you may no doubt understand if we mention that a lead salt is used in making the gowns to protect the operator.

A. 3. The telegraphone was actually constructed for experimental purposes and only 200 feet of wire was used. You may use any length of wire you desire by increasing the size of the spools to hold it. You will be able to purchase steel wire from any dealer in electrical supplies, and he would no doubt be able to quote you prices on small gear wheels.

BLOCKING CONDENSER.

(362.) Frank Haverland, Jr., Madison, Neb., wants to know: 1. The wave length, power and time of operation of the Fort Omaha radio station. 2. Correct capacity for a blocking condenser to be used with a loose coupler.

A. 1. W. V. H. is under Government ownership and is likely to operate at any time of day. The power, we believe, is about 3 kw. and operates on a wave length of 600 meters.

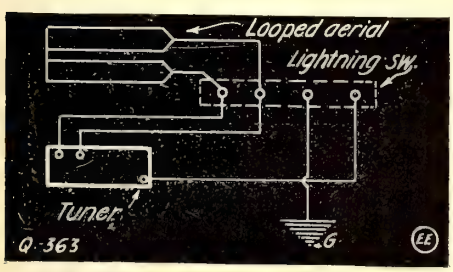
A. 2. A blocking condenser for use with a loose coupler should have a capacity of .075 M.F. If the 'phones are connected across the condenser it is advisable to utilize an adjustable type for this purpose.

AERIALS AND LIGHTNING PROTECTION.

(363.) Allen Sjoholm, Chicago, Ill., asks: 1. How a loop aerial can be connected to a S. P. D. T. lightning switch. 2. Which type of aerial is best for sending and receiving—a loop or a straightaway aerial. 3. If a carborundrum detector requires a battery for its successful operation.

A. 1. A loop aerial cannot be connected to a single-pole double-throw switch for lightning protection, but by adding an extra clip as shown in the drawing it can be done. This protection can then be afforded by wiring the switch as shown.

A. 2. It has been found that the loop aerial is superior for receiving because it is a closed circuit and does not reradiate received energy, while the straightaway aerial is better for sending because it does not require an anchor gap in the aerial.



Looped Aerial Lightning Switch.

You may arrange an aerial switch so that you use a loop aerial for receiving and a straightaway for sending, as shown in the July, 1914, issue of *The Electrical Experimenter* on page 44.

A. 3. A carborundrum detector requires a battery of about 3 volts and a potentiometer for its proper operation, as it requires a close regulation of the voltage to get this detector adjusted to its most sensitive condition.

RECEIVING TUCKERTON.

(364.) Max Clinch, Lakewood, N. J., asks several questions: 1. The use of a tikker on damped waves. 2. Regarding detectors. 3. Schedule and wave length of the Tuckerton station.

A. 1. It is possible to receive time signals from N. A. A. (Arlington) by using a tikker, but it has been found in actual practise that a detector responds best to slightly damped waves. You should use the tikker when receiving from stations which use undamped waves, such as Tuckerton or the Federal Wireless Telegraph Co., which use the Poulsen arc system.

A. 2. It is generally admitted that the galena detector is the most sensitive of mineral detectors, while the ordinary Audion, particularly when used as an amplifier is really the most sensitive extant.

A. 3. The wave length of the Tuckerton station is very high, about 7,500 to 8,000 meters, and it has no special time for operating, being a commercial station, but can be heard nearly every evening about 11 o'clock.

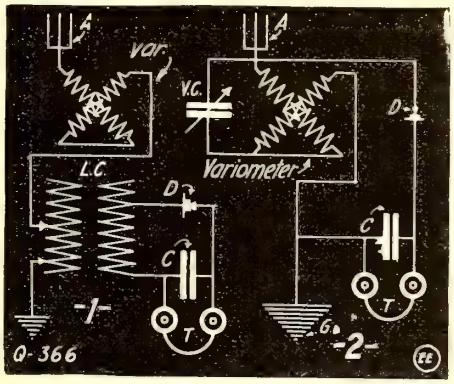
HOOK-UPS.

(365.) Clifton F. Taylor, Waltham, Mass., asks for a hook-up for a wireless outfit.

A. 1. Q. No. 355 shows the proper wiring for the apparatus you mention, but we would suggest the addition of a variable condenser to your outfit. This condenser is shown in the drawing and it increases the flexibility and range of the station vastly.

LINE INDUCTION AND VARIOMETERS.

(366.) Casimir H. Jaraszewuz, Chicago, Ill., asks several questions: 1. Whether a current of 4,400 volts used for railroad work would affect a wireless set located 200 feet from the said circuit. 2. The principles and construction of a variometer.

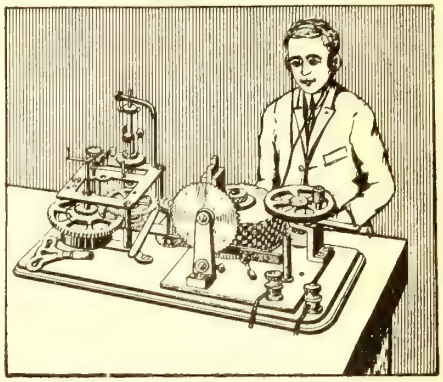


Variometer Hook-Ups.

A. 1. Since your aerial is located at right angles to the wires carrying 4,400 volts, it will have little or no effect on your set beyond a humming sound that may be slightly noticeable.

A. 2. Drawing shows two connections for a variometer. The first illustrates a variometer used as a loading coil, and the second how it is used by the Telefunken Co. for tuning purposes. A variometer consists of two concentric coils of wire, each containing an equal value of induct-

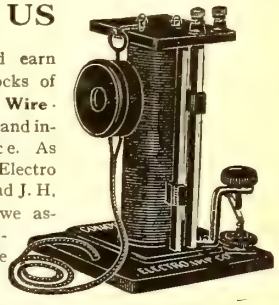
LEARNING TELEGRAPHY



becomes simple when your instructor is the Omnigraph Automatic Transmitter. Combined with a standard key and sounder or Wireless Buzzer, it will send you telegraph messages at a slow speed, which can be increased at will to match the sending of an expert operator as you become more proficient. Adopted by U. S. Gov't. Made in 4 styles, from $2.50 up, all accurate. Circular free.

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You, too, should earn of our large stocks of **Electrical and Wireless Apparatus** and intelligent service. As agents for The Electro Importing Co. and J. H. Bunnell & Co. we assure you of quality merchandise at lowest prices.

Quaker Light & Supply Co., 728 Arch St. Phila., Pa.



Only $5.00

If you would like to get louder signals, make your station more selective and receive longer distances, get this efficient Receiving Transformer. Send two-cent stamp for Bulletin 105, just out.

Colby's Telegraph School, Auburn, N. Y.

"Construction of the Audion Amplifier"

with working drawings, particularly describing the transformer. Price, 50 cts.

THE MISCELLANY, 17 Board of Trade, KANSAS CITY, MO.

BOSTON WIRELESS

Boston Receiving Transformer, $7.50
Variable Condenser, 25 Plates, $2.75
Boston Detectors, $1.00, $1.25, $1.75, $2.25, $4.00

Agent for Electro Importing Co. and A. W. Bowman Co., Manhattan and Adams Morgan Spark Coils, Ever-ready flash lights and batteries. Catalog for stamp only.

M. MUELLER, 18 Devonshire Street, BOSTON, Mass.

1 Microfarad Condenser

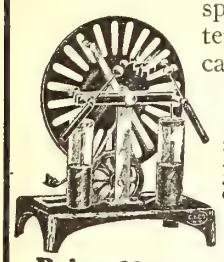
cast in metal box with 2 binding posts. Insulation good for 800 volts

Regular Price, $7.00; Special Price, for cash with order $2.00

Rosenthal Laboratories, Camden, N. J.

WE carry a very complete line of Wireless Apparatus in stock, being Chicago headquarters for the Electro Importing Co. Same prices, same goods and Free Wireless Course. The Static Machine shown here is an example. Just turn the handle and get 2 and 3-inch sparks. Price, $3.75. No batteries required. We also carry a complete line of Electric and Auto Supplies.

Send 4c. in stamps for our 3 complete catalogs.



Price $3.75
No batteries required.

LA SALLE LIGHT COMPANY
134-136 N. La Salle St., Chicago, Ill.
(Opposite City Hall)



No. 10 Tungsten Flashlight

6 inches long, complete, 65c. Extra bulb, 15c. Extra battery, 25c.

No. 125 Tungsten, Nickel Vest Pocket Flashlight with Tungsten bulb and Ever-ready battery complete, 49c. Extra bulb, 15c. Extra battery, 25c.

Nitrogen Lamps are the latest type of Electric light and use 50% less current than the old style lamps. They also give you twice the light for the same current.

PRICE LIST

60 Watt.	$0.90	400 Watt.	$4.00
100 "	1.00	500 "	4.50
200 "	2.00	750 "	6.00
300 "	3.00	1,000 "	7.00

Send 4c. in stamps for our 3 complete Catalogs and bargain sheet of raw material and lesson coupon.



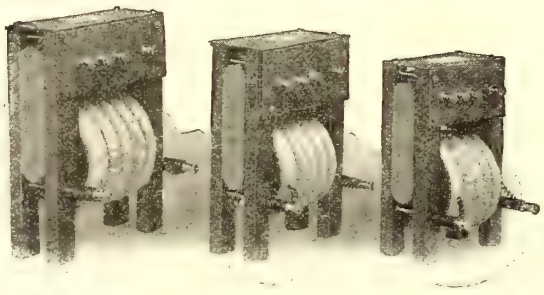
Winger's Closed Core Transformers

14,000 VOLTS
Perfectly Insulated.

¼ K.W.	$10.75
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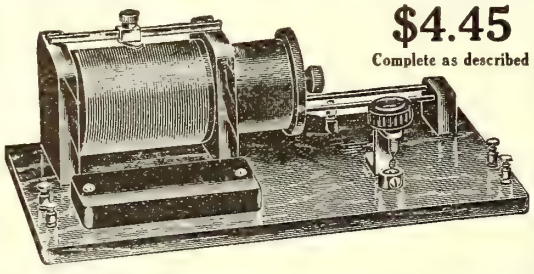
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ance. The inner coil has a knob fastened to it, so that the planes of the two coils may be changed. The two coils are then connected in series, and when placed so that they help each other; that is, so that their respective magnetic fields are assisting each other, the inductance is at its highest value. As the inner coil is slowly turned out of the plane of the outer coils the inductance changes, and when turned through an angle of 180 degrees the two coils will be opposing each other and the algebraic sum of their inductances will be zero.

WAVE LENGTHS.

(367.) W. J. Gravely, Danville, Va., inquires: 1. About the stations that have the same sending range as the Arlington station. 2. The wave length Sayville is now using. 3. The sending range of the Wanamaker station in New York and its wave length.

A. 1. Stations on the Eastern coast having a range equal to the Arlington station are: Sayville (W. S. L.), Key West (N. A. R.), Colon (N. A. X.), Tuckerton (W. G. C.).

A. 2. Sayville uses a wave length of about 2,800 meters, and sends "press" to ships from 8 to 11 p. m. daily.

A. 3. The Wanamaker station, New York (W. H. I.), uses 2 kw. and has a sending range of about 250 miles under all conditions, and operates on a wave length of 600 meters.

INVESTIGATIONS IN LECLANCHE PRIMARY BATTERIES.

A new and commercially valuable investigation of the construction and chemical reactions of the Leclanche cell, the form of primary battery used so extensively for ringing bells, buzzers, etc., and in dry cells operating portable flashlights, bells, igniters, etc., has been undertaken by Ernest G. Crocker, of the graduating class in electrochemistry at Massachusetts Institute of Technology.

The polarization was found to be due to an alkali effect of ammonia, previously referred to as hydrogen, and experiments were made with different sizes of the grains of materials contributing the dry battery, and various ratios of one of the materials to the other for efficient work.

It was found that the fineness should be between 1/40 and 1/100 of an inch, and contrary to the custom of some manufacturers, the two constituents should be of the same size. The materials used are carbon and pyrolusite, and the quantity of the latter should be about 60 per cent. of the whole mixture.

Mr. Crocker found the best material for removing the alkaline effect is chloride of zinc. The practical result of batteries constructed according to the formulas deduced from the experiments is that they will remain more constant in current production under light continuous use.

PATENT ADVICE

Edited by H. GERNSBACK

In this Department we will publish such matter as is of interest to inventors and particularly to those who are in doubt as to certain Patent Phases. Questions addressed to "Patent Advice" cannot be answered by mail. Sketches and descriptions must be clear and explicit. Only one side of sheet should be written on.

Telephone Lock.

(28) Henry Lewis, Toronto, Canada, has submitted a model and sketch of a telephone lock and desires to have our advice if it is patentable and whether it is a practical apparatus; it is to be used in locking telephones so that unauthorized parties cannot use it.

A. We have carefully inspected the model and drawings and find that as far as we can tell the invention is original. We think there is a good chance to obtain a patent on it.

We would, however, desire to caution our correspondent that up to this time telephone locks have not been very popular and they are hardly ever used at all for some curious reason.

Foreign Patents.

(29) Victor Stefano, Newark, N. J., wants to take out a patent, and he is particularly interested in obtaining patents also in Germany, France and England. He wishes to know if we can give him the addresses of some trustworthy attorneys in these countries.

A. It is common practise that if you take out a patent in this country that you let your attorney take care of your foreign patents also. Nearly all reliable attorneys in this country have corresponding attorneys in Europe, as well as the other continents, and they are in a position to do the work better for you in this manner than if you sent the patent direct to foreign attorneys.

Gun-Flashlight.

(30) Alfred S. Turner, Lynn, Mass., has sent us a description and draft of a gun-flashlight, the idea being that the flashlight is operated by means of a trigger before firing the gun.

A. This invention is not new and various patents have been allowed on precisely the same arrangement. We believe there is a concern in existence now that manufactures revolvers that have a flashlight mounted underneath the barrel, and from this you can see that there is hardly a chance of your obtaining a patent on this idea.

Nickel Plating Paste.

(31) Howard Armstrong, San Diego, Cal., has invented a nickel-plating paste and submits a sample of the paste to us. He wants to know whether a formula of this kind can be patented and whether such an article is in demand.

A. We have examined the paste in question and find that it works indeed very well and seems to give a good plating as far as we can tell. We have not made an analysis of the paste to find out what it contains, nor do we know if the nickel-plating will not peel off in time.

There is probably a good chance that a patent can be obtained on the formula, though we cannot be certain, for the reason that quite a good deal of this work has been done before.

A very large concern a few years ago started to sell some nickel, silver and gold powders which gave an electro-chemical deposit simply by wetting the powder. We understand that while the article was a very meritorious one, the company went out of business as there was probably not sufficient demand for the article. A large advertising campaign was carried on, but it seemed to be of no avail.

Incandescent Lamp.

(32) Alfred Schneider, Boston, Mass., has perfected an electrical invention covering an incandescent lamp and he desires to know whether he could go ahead manufacturing same or selling it to a manufacturer as soon as he has applied patent on the invention; he furthermore wishes to know how long it takes an invention to be patented at the Patent Office.

A. We most strongly advise against doing any commercial work on an invention or offering it for sale before the patent has been allowed. It sometimes takes years to get a patent, particularly in an art where much previous work has been done, as, for instance, in your invention. You are probably aware that there are hundreds of patents in existence on incandescent lamps and it is therefore almost certain that it will take a minimum of one year before the patent can issue. Of course, this is presuming that the invention is an improvement over something else. If, however, the invention is radically different from anything existing so far and presents a basic idea, it probably would take quite a little less time for the patent to issue.

As a rule we would caution inventors not to enter into any agreement with any firm or individual to manufacture an article which has not been patented. Only in extreme cases does such a course prove profitable. The reason for this is that very often the first idea of the invention is very crude and the article in question will stand quite a lot of perfecting. For this reason if an invention is given to a manufacturer and he should improve upon it in such a way as to alter the original invention the inventor would have no recourse in case the manufacturer desired to manufacture the article in question without paying the inventor royalties.

DODGES HURRICANE BY AID OF WIRELESS TIP.

The 85 passengers recently arrived at New York from Central American and West Indian ports on the United Fruit steamer Pastores wrote their thanks to Captain Henshaw for bringing them home in calm weather.

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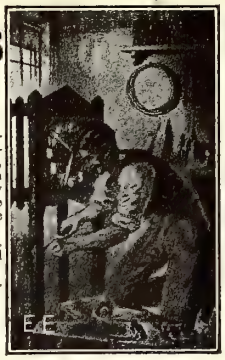
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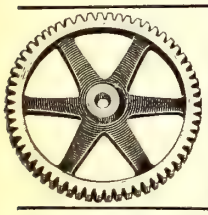
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EXPERIMENTERS—INVENTORS



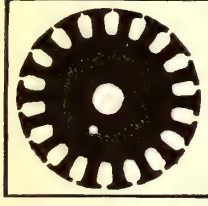
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EDITOR'S CHAT.

You will observe that we have increased the size of the *Electrical Experimenter* once more, the *fifth* enlargement in *seven months.* Nor are we going to stop, for there will be a further increase in pages next month. Where else can you find a similar 10c. magazine containing 72 pages, 118 illustrations and 120 articles? Where else can you find the latest and most up-to-date electrical matter and *such* illustrations as are presented month in and month out in this journal? You know by this time that each and every issue eclipses the one preceding it, and you know what to expect. If money and brains can produce a better magazine than ours, we would like to see it.

There will be some distinctly new features in the December issue, which we know will please the wireless enthusiasts—something entirely new; watch for it. There will also be some very original stories, up to our usual standard and even eclipsing former ones.

As you see, we are doing our utmost to please you and to give you the very best to be had anywhere, and all we ask of you to-day is your co-operation, to make this magazine still bigger, still better. Surely you have a friend or an acquaintance who perhaps has not seen the latest issue of the *E. E.* Why not help the good work along by sending his name to us TO-DAY, so that we can send him a sample copy?

Also, as we stated once before, we could never hope to publish such a wealth of matter if it were not for our advertisers. The advertiser "pays the freight" and he it is who has made the *Electrical Experimenter* what it is to-day, the foremost popular electrical magazine in this country.

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To establish a line of wireless stations in Southeastern Alaska, which will afford that territory wireless connections with the world-wide wireless service which the Marconi company is planning, is the latest ambition of that corporation. Stations will be located at Ketchikan, Juneau, Sitka and Skagway and a low rate night letter service between Seattle and these stations will be established.

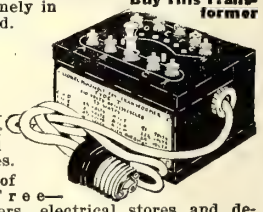
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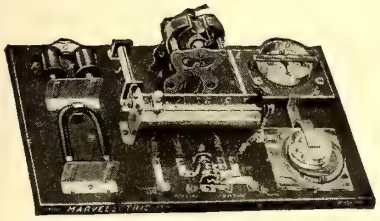
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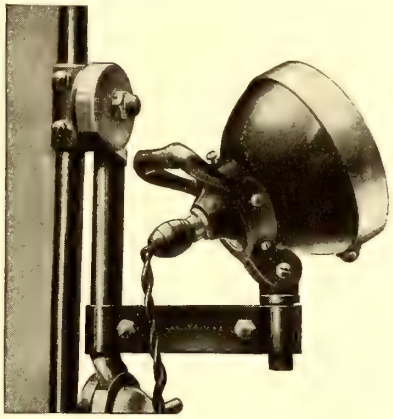
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Due to this accessible adjustment, the lamp may be transferred from one car to another of different voltage at will. It also enables the user to select a bulb to suit his requirements, and in case of accident to use any available bulb as a renewal. Should it become necessary to use the searchlight to take the place of the headlight, the width of the illuminated field can be increased as desired.

Another feature of this ingenious search lamp is the double curvature parabolic reflector which, though only five inches in diameter, produces as much beam candle power as any large automobile headlight, with even distribution of light.

A minor feature but one of considerable convenience is the design of the handle, which serves as a stand for holding the lamp in an upright position when detached for repairing tires, etc.



Auxiliary Searchlight for Autos.

BRITISH RELEASE AMERICAN WIRELESS OPERATOR.

C. J. Maisch, of New York, wireless operator on the Norwegian steamer Seattle and a native-born American citizen, who had been held in custody since the Seattle was captured near the Falkland Islands on March 14 last, has been released as the result of representations made in his behalf by the American Embassy.

The plight of Maisch was made known in July by the American Minister at Montevideo, Uruguay. The Foreign Office informed the American Embassy that the man had sailed on board the steamer Bangor from the Falklands. The next heard of him by the embassy was a report from the American consul at Plymouth, England, who said he had been held to give testimony in prize court in case the Bangor, which has been renamed the Seattle, arrived in Plymouth in charge of a prize crew.

WIRELESS FOR MEXICO CITY.

A wireless telegraph station has been erected in Mexico City, according to a cablegram received at the Carranza consulate from Vera Cruz, and radio communication between the capital and the outside world, it is said, will be established soon. Preliminary trials between Mexico City and Vera Cruz have been satisfactory, according to this report.

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9 Different Voltages

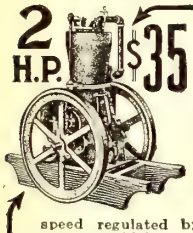
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It fires every shot with speed regulated by exclusive auto-throttle govenor which means even, economical power.

It will operate electric light plant, pump water, run separator, churn or freezer, chop feed, operate machinery, in fact, it is "the engine for every work."

Hopper cooled complete ready to run, 2 H. P., for only $35. Direct to you from the factory. Write for catalog.



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Special price $5.50 with this advertisement only.

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Three Stores in N. Y. 421 Broadway
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This is worth **$1.45**

Don't pass it up—Cut it out.

HIGH FREQUENCY CURRENTS.

(*Continued on page* 329.)

wire motor, and in further tests made by Tesla with very powerful apparatus it was found possible to make a device of this character operate with simply a ground connection and the other electro-magnet terminal joined to an insulated capacity or plate suspended in the air. He has also, by this and other arrangements, produced a *wireless light* which can be lighted at a considerable distance from the generating station. He claims in his patents that it is easily and simply possible to thus generate vast quantities of high frequency electrical energy and to transmit it for hundreds, nay, even thousands of miles, where it will be picked by an elevated capacity or aerial joined to a suitable translating mechanism, such as a transformer and motor, etc., having its second terminal connected to earth.

A fact not usually considered and which seems to possess considerable promise in this direction, as well as in many other lines of electricity's application, is that of *freezing* the high frequency or other circuits so as to reduce the resistance to an inappreciable value. Tesla mentioned this in one of his early patents over 20 years ago, and lately very commendable work has been done in this direction by Prof. Kammerlingh Onnes, of Holland. By suitable refrigerating apparatus of special type, which can produce a cold approaching that of absolute zero, or nearly so, it has been ascertained that if induced currents are set up in such a refrigerating circuit, then it is possible for that initial flow of current to pass on around that circuit for a very considerable period of time before it dies down to zero. In some of the later experiments it was found possible for such a current to oscillate around a circuit for many hours before exact measurements with a galvanometer, properly joined to the circuit, indicated that the current had depreciated in value to any great extent. This is an important point which as yet has remained undeveloped, and it seems very possible that it could be worked out with up-to-date and perfected refrigerating apparatus so as to be applied to wireless telegraph sets, particularly those employing high power, where there is a great amount of heating and considerable losses occasioned thereby. As is well known, in such high frequency circuits the resistance plays a very important part, as it acts directly with respect to the *damping* of such a circuit.

(*To be continued.*)

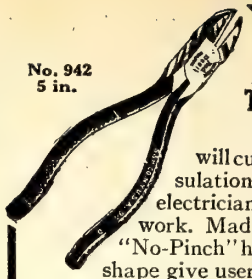
DANIELS NAMES NAVAL ADVISORS.

(*Continued from page* 323.)

American Society of Aeronautic Engineers—Henry Alexander Wise Wood, New York City; engineer and manufacturer of printing machinery and student of naval aeronautics. Elmer Ambrose Sperry, Chicago; Cornell, '76; founder of Sperry Electric Co. and designer of electric appliances and gyroscope stabilizer for ships and aeroplanes.

WIRELESS STATION AT FT. ADAMS, R. I.

Plans for the erection of a high power wireless telegraph station at Ft. Adams have become known with the arrival of material for the plant. This station, it is understood, will be the first of a projected chain of towers for communication between the principal army centers of the coast. The naval system already covers much of the coast line for that branch of the coast defense.



No. 942 5 in.

"RED DEVIL" Hand Honed and Tested Diagonal Cutting Plier

will cut the finest silk insulation. The standard electrician's tool for exacting work. Made drop forged steel. "No-Pinch" handles of scientific shape give user a firm grip. Sample 5 in. pair sent for 80c. BOOKLET OF MECHANICS' TOOLS FREE.

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UNIQUE ELECTRICAL SOLDERING IRON.

The object of this new electric soldering iron is to form or generate heat directly at the point of contact, and only at the spot where the heat is needed for soldering purposes, whether it be electric wires, armatures or cable work.

You do not have to wait for the iron to get hot, as the instant the object to be soldered bridges the two carbon or carborundum high-resistance heating points these points glow with a white heat directly at the tips of the high-resistance material, therefore conducting the heat directly to the spot needed.

When the object is soldered, the moment the tool is taken from the work the current ceases to flow, as the circuit between the high-resistance points is opened; this creates a great saving of current and also time. The iron is always ready for use. The high-resistance points will last indefinitely, and if they should become injured can be readily renewed, say the manufacturers.

There is no loss of heat through conduction or radiation, as will be found in the old-style electric soldering iron. It is used in conjunction with a small transformer, and will solder from the smallest to the largest work, depending upon the amount of electrical energy that the iron and transformer are constructed for. Where it takes an ordinary electrical soldering iron of the old style to solder a No. 14 wire splice 10 seconds, this new iron will solder the same splice in from three to five seconds; in fact, any job can be soldered in less time with it than by any other means, whether it be a blow-torch, the old-style electric iron or acetylene gas generator.



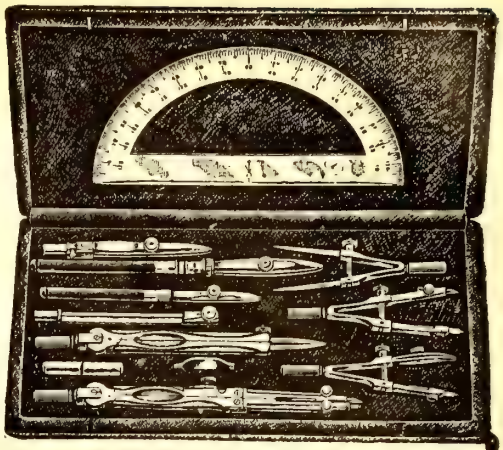
New Electric Soldering Iron.

This iron is thoroughly covered by patents issued and pending in all principal countries of the world, and a new factory is being built for the sole purpose of manufacturing this new electrical soldering iron.

RUSSIAN COMPANY OF WIRELESS TELEGRAPHS AND TELEPHONES.

The annual general meeting of the Russian Company of Wireless Telegraphs and Telephones (Russian Marconi Company) was held in Petrograd on June 13, Vice-Admiral Bostrem, chairman of the board, presiding. The directors' report and accounts for the year ending Dec. 31, 1914, record a largely increased turnover in the business of the company, mainly due to orders received from the Russian Government. The company declared a dividend in respect of the year 1914 at the rate of 15 per cent., which was payable on July 13, The retiring directors, Godfrey C. Isaacs and P. I. Balinsky, were re-elected, and the meeting passed a vote of thanks to Mr. Balinsky and L. M. Eisenstein and their staff.

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YES, I will give you this complete set of drawing instrutments absolutely free. They are regular working instruments—the kind I use myself and they do not cost you a penny. And besides the instruments in this exquisite plush lined leather case, I will give you absolutely free a 20x25 inch drawing board, a 24 inch T-square, a 12 in rule, a supply of drawing paper, two triangles, a French curve, pencils, erasers, thumb tacks, etc., etc. A complete draftsman's working outfit. And I give it to the men who get my personal instruction absolutely free.

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I am Chief Draftsman of a large and well known firm. I have been doing the highest paying expert drafting work for a qaarter of a century and I know the kind of training that is demanded from the men who get the big salaries. I will give you personal instruction, deal individually with you and give you up-to-date, practical working plans just as your ability and advancement require. I train you by giving you actual work—practical work, the kind that you must be able to do in order to hold permanent, big paying positions. I will give you my indivdual instruction. If your work is right, I will advance you rapidly. If it is wrong, I will show you where, and make you do it right, and do all I can to make you an expert draftsman and designer in a short time. ***Write today without fail.***

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Put your name and address on the free coupon or a letter or a post card and send it to me today. I will send you absolutely free and prepaid my new book "Successful Draftsmanship," and the great special offer that I am now making on which you get the $15.00 Draftsman's Working Outfit **absolutely free.** You assume no obligations of any kind in sending in the coupon. Get in line now for a big paying position. Getting the book and full particulars of the special offer is the first step.

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the same kind of credit you get from your grocer. No matter where you live or what your income might be, you can now own the finest of watches, a beautiful diamond or any rare jewelry and never miss the money.

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AN ELECTRIC RANGE FOR THE CHILDREN.

Playing "keeping house" has always been a favorite pastime with little girls. Just as the stove in mother's kitchen is



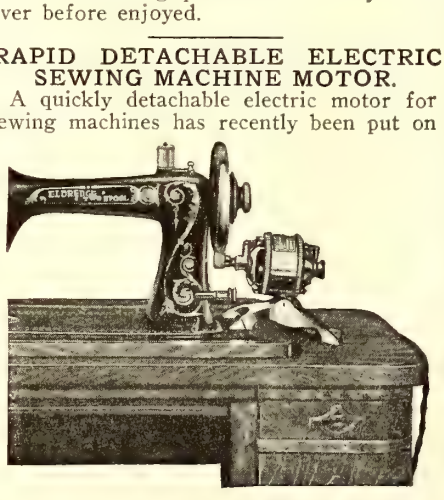
Toy Electric Range.

important in household work, so in play the toy stove is important to the miniature mother, although these stoves have until the present been only "make believes." Toys of the children are now being made to follow advances in the home. A striking example is a miniature electric range so devised that it is a practical little cooker. The range is 15 inches in height and is capable of cooking real food. It is equipped with an oven 4½ inches wide and 5 inches deep—big enough to hold a little roasting pan.

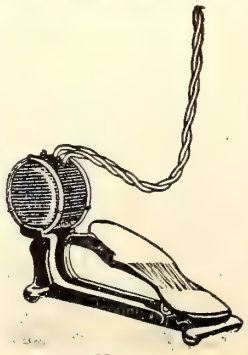
On top of the range a kettle can be placed, or food can be cooked in tiny utensils that come with the range. A long cord with plug is furnished to attach to any handy socket, and, best of all, there is a cord switch, which controls the amount of electric heat sent to the range. Little girls fortunate enough to get a toy electric range for Christmas will find "playing house" a more fascinating pastime than they have ever before enjoyed.

RAPID DETACHABLE ELECTRIC SEWING MACHINE MOTOR.

A quickly detachable electric motor for sewing machines has recently been put on



Above: Note Motor is not screwed to machine, but is held by friction. No screws or bolts are used.



New Sewing Machine Motor.

the market, and is herewith shown. The motor is small and compact and supported



Your Washing Done for 2c. a Week

Electric or Water Power Will Do the Work

I have built a new "1900" power washing machine. I consider this machine the most wonderful washer ever put on the market. Built entirely of high quality sheet copper, it is the strongest and most durable machine made. It is constructed on a brand new principle and I will guarantee that this machine will not tear clothes, break buttons or fray the edges of the most delicate fabric. It will wash everything from heavy blankets to the finest lace without damage to the goods.

This new "1900" washing machine can be connected with any electric socket instantly and is started and stopped by a "little twist of the wrist" and it will do your washing for 2 cents a week.

I also make a lighter power machine which can be run by water or electric power. On all of these machines the motor will run the wringer too. Just feed in the clothes and this power wringer will squeeze the water out so quickly and easily you will be astonished. It will save 50 per cent. time, money and labor every week. The outfit consists of washer and wringer and either electric or water motor, as you prefer, and I guarantee the perfect working of each.

I will send my machine on 30 days' free trial. You do not need to pay a penny until you are satisfied this washer will do what I say it will. Write today for illustrated catalog. Address: H. L. Barker, 6207 Court St., Binghamton, N. Y., or, if you live in Canada, write to the Canadian "1900" Washer Co., 355 Yonge St., Toronto, Canada.

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Uni-Lectric lighting plant generates standard 110-volt direct current; operates from one to 50 lights, electric motor, electric iron, vacuum cleaner, electric toaster, force pump, churn, washing machine, etc.

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and a **better** machine for **less** money. High speed gasoline motor, generator and automatic governor, all complete in one small, compact unit. Uses standard lamps and fixtures. Simple, easily installed, dependable, economical. Costs less than other systems to buy and to operate

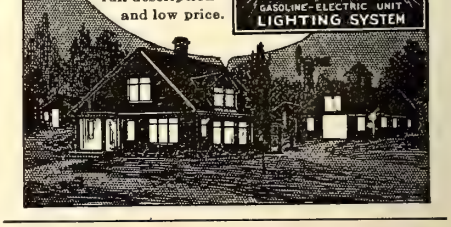
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He'll fit you for a good job as chauffeur, tester, repair man, salesman, etc., in 3 to 5 weeks. Sam teaches you personally—is right on the job every minute. Established six years.

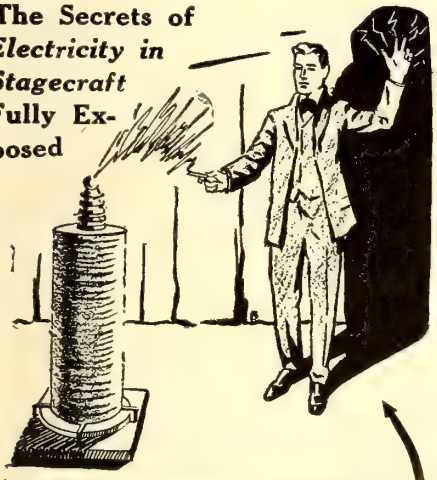
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Good jobs everywhere are waiting for good men. Complete equipment to work on; 4, 6 and 8 cylinder cars for students' work. No theory. Sam is practical. Short on lectures—long on actual, practical work. When you finish you are ready to tackle any auto problem. You're as good as the best. Sam does a good job. Learn from a practical mechanic. I have a fine 3 story building, at 1513-21 Prospect Ave., and 1520-26 Brownwell Court. Welding and Bronzing Depts.; large, well equipped machine shop; Radiator, Fender and Tire Depts. Start in at once. Drop in and see me, or write—Sam Brown.

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on a special frame having four legs, on which two rubber plugs are set under each leg to prevent scratching the woodwork of the machine. These serve also in keeping the motor from moving around. The motor is pivoted upon a shaft, upon which a spring is so set that it forces the motor in an upward direction. A small cork pulley is fastened onto the shaft of the prime mover. This pulley is used for driving the hand-wheel of the sewing machine as the photograph illustrates. The tension of the spring keeps the friction wheel of the motor at a constant pressure against the hand-wheel of the machine, while the rubber plugs under the feet keep it from moving around. In order to remove the motor it is only necessary to press it down and pull it away. The motor runs both on alternating or direct current; it can also run in either direction, just by removing a screw and changing the position of the brushes on the commutator. A small foot-operated rheostat is furnished with this detachable motor, and this is depicted in the second illustration. This device can be used on any sewing machine, as there are no detachments nor screws needed for installing the motor.

VOICE CONTROLLER FOR TOY ELECTRIC TRAINS.

The *controlophone* is a Twentieth Century toy. Simply talk to it and you can start and stop your electric trains, motors, etc., and light and put out miniature electric lights at will.

The controlophone will work on any



Voice Controller for Toy Railways.

voltage toy electric trains will run on, and it will also work on either alternating or direct current.

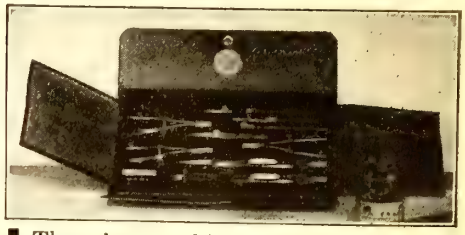
To operate this device by the voice, the word which operates it must be emphasized sharply, and it is best to make this the last word of the sentence, so as to keep the instrument from repeating. Take the sentence "Start the TRAIN." The word "TRAIN" must be pronounced sharply. Words like TRAIN—PLEASE —TWENTY—QUICK, or ones which can be forced, are the best to use.

After using the controlophone a short while, one acquires a code, whereby one can work certain words into any sentence.

If the train is at a standstill, you can say to the controlophone "Start the TRAIN." This will put the mechanism into action and the train will start and keep going until you say "Stop the TRAIN." It will then stop.

Diagrams for wiring are furnished by the manufacturers whereby you can say (no matter where the train is) "Stop the train at the station, PLEASE," and the train will stop.

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This Complete $15 Drawing Outfit and Full Instructions in Mechanical Drawing **FREE**



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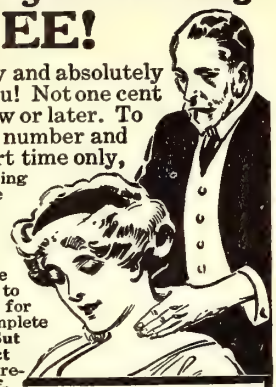
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BOOK REVIEW

Craig's Q. & A. Book. (Questions and Answers about Electrical Apparatus). Revised, Third Edition. 1914, by James W. Craig and William P. Woodward. Flexible leather covers. 256 pages. 4½ by 6¾ inches. Pocket style. Profusely illustrated. Price $1.50. Supplied by Electrical Review Publishing Co., Chicago, Ill.

The third edition greatly revised and brought up-to-date of this practical handbook, written in question and answer form. This is one of the best books of its kind to be had and many valuable features are incorporated therein, such as illumination, D. C. and A. C. motors, transformers, watt-meters, integrating watt-hour meters, voltmeters and ammeters.

Power factor meters, compensated voltmeters, etc., are covered. Not only are ordinary questions answered, but a host of extremely practical yet unusual ones, such as, for instance, "Can a D. C. voltmeter of the Weston type be connected up to an alternating current circuit?" Such problems as these and hundreds of others on the commercial side of electrical matters are explained quite fully, so that the everyday electrician can grasp the underlying principle easily and quickly.

Wireless Telegraphy. By A. B. Rolfe-Martin, B.Sc. 1914. Cloth covers, 256 pages. 5½x7½ inches. 143 illustrations. Price $2. The Macmillan Co., New York, N. Y.

A new volume in radiotelegraphic literature which has many valuable points in it not commonly known to the average wireless man and especially the young experimenter or operator. The apparatus used in the Marconi and Telefunken systems for special purposes, such as magnetic non-sparking keys, microphonic amplifiers, lightning arresters, etc., are explained clearly with diagrams and sectional drawings. Many of the features incorporated have never been published before. The work starts with electromagnetic waves, condensers, coupled circuits, syntonic developments to date, etc. Also damping or decrement is discussed and the calculations cited for this work in a thorough manner. Directive radiotelegraphy, continuous wave systems, the various transmitting and receiving circuits now used, etc., are treated upon in a lucid way. Much can be learned from this volume by Mr. Rolfe-Martin, and it should be read by all those interested in any way in the art.

NEW OHIO RADIO CLUB.

There has recently been formed in Wooster, Ohio, a club known as the "Wooster Radio Club." The club has ten charter members and several prospective members. The officers are as follows: Morbet Lee, president; Wm. Strong, vice-president; George Limb, secretary; Paul Keehn, treasurer, and John Carlton, station inspector. We believe that the office of "station inspector" is practically new among amateur clubs. His duties are to inspect the stations of each member of the club at intervals of eight weeks and to report the conditions and improvements in same at the first meeting of the club following his inspection. He also inspects the stations of persons applying for admission and furnishes a complete description of such stations to the club. In case the applicant is found ineligible, it is the duty of the station inspector to inform him as to how he may fulfill the requirements of the club.



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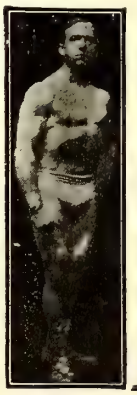
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PROF. H. W. TITUS
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WIRELESS TELEPHONY NOW FROM WASHINGTON TO HONOLULU.

(*Continued from page* 321.)

sage was sent to Hawaii is greater than that between New York and London, New York and Paris, greater even than from New York City to the North Pole!

From New York to London is 3,740 miles; to Paris, 4,020; to Berlin, 4,385; to Bremen, 4,235; to Antwerp, 4,000, and to the North Pole, 3,435 miles.

Owing to the lack of adequate sending apparatus at Honolulu it was impossible to communicate back to Washington, but a cablegram announced the fact that the message had been received and distinctly heard.

The account of the successful experiment was given out by James D. Ellsworth, of the American Telephone & Telegraph Company. He said in part:

"Wireless telephony from the Atlantic seaboard to Hawaii, a distance of 4,600 miles, is an accomplished fact. By the special wireless telephone developments which have been made by the engineers of the American Telephone & Telegraph Company and of the Western Electric Company (which concern made all the apparatus for this remarkable long distance test, including the vacuum tubes), speech was transmitted from Washington to a wireless station near Honolulu. If anything further was needed to show the wonderful capacity of these new discoveries by the engineers of the Bell system, this last triumph, coming but a few hours after Mr. Vail, the president of the company, had talked by wireless from Washington to Mr. Carty, its chief engineer, located at Mare Island, is conclusive.

"That transatlantic wireless telephone communication is assured as soon as the disturbed condition in Europe will permit of tests from this country to there, is obvious when it is remembered that all scientists agree on the fact that it is much more difficult to send wireless telephone communications across land than across water. This wireless telephone message from Washington to Hawaii had to pass over the whole of the United States—a distance of 2,500 miles—before it encountered better wireless conditions which exist when sending over large bodies of water. For the purpose of this test the sending was done from the navy wireless station at Arlington, just outside of Washington. The receiving was done on a small wireless antenna specially erected for the purpose by the engineers of the telephone company, which, by permission of the naval authorities, was located at the naval station at Pearl Harbor, Hawaii.

"The message at Honolulu was received by Lloyd Espenchied, an engineer of the American Telephone & Telegraph Company, who had been sent there by Mr. J. J. Carty, its chief engineer, to take charge of the observations, the successful results of which we are now able to report.

"Another interesting feature of the tests was that, in a practical way, the ability to connect wireless telephone systems with wire telephone systems was shown. You have no doubt noted that Mr. Vail in his talk used a wire circuit from New York to Washington. At Washington, by the special means invented and developed by the engineers of this company, the wires were connected to our special wireless apparatus and to the navy's mighty wireless tower, where the message went wirelessly to its destination."

The exact apparatus used in this phonomenal test of the wireless telephone is being kept a secret owing to patent reasons,



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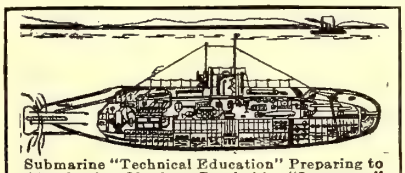
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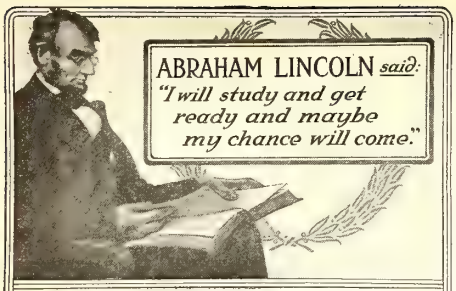
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etc. However, it is understood that an audion type amplifying detector was used at the receiving end, which apparatus boosts the strength of the received signal to a high degree. At the sending station a new form of vacuum trigger tube, devised by Dr. Langmuir and known as the Pliotron, played an important part. This tube, of which 300 were used in a bank, was described in a previous issue of *The Electrical Experimenter,* and permits a large amount of energy to be controlled easily by a simple microphone of the type used on the standard telephone desk set. A distinct trigger control circuit enables this to be accomplished in a simple and positive manner.

The following details of the apparatus used for transmitting wireless talk from Arlington to Honolulu are given through the courtesy of Dr. Lee de Forest. The transmitting plant comprised 300 regenerative vacuum tubes (each bulb measuring 7 inches in diameter), and these were excited on 250 volts direct current. The bulbs were arranged on six panel boards, 50 to a panel. Each panel consumed 50 kilowatts, thus making a total of 300 kw. of energy absorbed, and the net output to the antenna was 70 kw. at 150 amperes. Each bulb, in other words, produced ½ ampere of radio frequency current. The *trigger control* grids of each bulb were connected to the secondary windings of small transformers, the primaries of which were hooked up in series with a suitable battery and a microphonic transmitter. Thus when transferring land-line talk (as from New York to Arlington) to the wireless sending circuits the regular Bell telephone receiver at the other end was caused to act on the microphone and the latter created the varying changes in the vacuum tube circuit, which variations in current were manifested finally in the antenna itself. The microphone had only to care for a small current, or about ½ ampere, to be exact. Thus the vacuum tube principle, highly developed and perfected by such indefatigable workers as Prof. J. A. Fleming, Dr. de Forest, Dr. Langmuir, Messrs. Lieben and Riez and others, has apparently solved the wireless telephone problem, which indeed had bid fair to baffle the scientific men of the old and new worlds for many years to come.

U. S. IS LACKING IN WAR WIRELESS, SAYS DE FOREST.

The American army is so poorly equipped with wireless stations and facilities that it would be easy, in case of invasion, for an enemy to cut the ordinary telegraph wires and completely isolate the East from the West, Lee De Forest, the wireless inventor, said at a recent meeting of the American Defense Society in New York City.

"The United States," he added, "urgently needs a chain of high-power radio stations extending across the continent. One old telegraph cable is all that binds us to solutely indispensable, but the United would quickly be isolated.

"In aeroplaning, radio telegraphy is absolutely indispensable, but the United States has almost no aeroplanes to equip. But the navy is up to date in radio telegraphy."

PORTABLE ARMY WIRELESS SENDS 44 MILES.

Army men at Fort Leavenworth record recently a record in having sent a wireless message 44 miles, using the United States Army's newest field apparatus, operated by the Fifth and Sixth divisions of Company A, United States Signal Corps. The older field radio machines seldom were capable of sending radiograms more than 35 miles.



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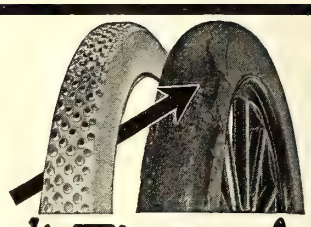
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BARON MÜNCHHAUSEN'S NEW SCIENTIFIC ADVENTURES.

(*Continued from page* 314.)

scientific prophecy, obtained by cold reasoning, reminded me of †Leverrier, the French astronomer, who by cold reasoning and mathematics on Aug. 31, 1846, predicted the existence of a new planet, Neptune, which no one had ever seen*†

"The Martian I was gaping at, who was standing nearest to me, was between eight and nine feet tall, a veritable giant. He had an immense head with a straight forehead at least seven inches high. His light blue eyes were about two inches in diameter and placed close together; moreover, they had a marvelously intelligent, as well as keen look in them, impossible to describe. Their hypnotic gaze held one spellbound and seemed to go clear through you.

"The long thin nose was enormous but harmonized well with the rest of the face; the complexion was somewhat brown. The large ears stood out straight and looked like enormous oyster shells, with the inside turned towards me. However, what caught my eye at once, was the strange 'caps' all Martians wore. These caps looked as if they were made of a flexible metal and from their back dangled what I thought to be a flexible metal wire. We were soon to know their purpose.

"The chest or rather the torso of the Martian was simply out of all proportions to the rest of the body. It was enormous, and made him look strangely top heavy. His arms appeared thin and emaciated, as did his limbs. His hands had each two thumbs and four fingers, the extra thumb being between the thumb and index finger, as compared to the human hand. The hand itself was very small; in fact, it looked much like a woman's hand on Earth.

"The feet were almost circular in shape and at least 1½ foot in diameter. The base looked very much like an elephant's foot, although the ankle was rather small and graceful, as compared to the big flat foot. The outside of the Martian's dress glistened strangely in the sunlight, and I felt sure that it must be made of a flexible metal, unknown to us. It fitted rather loosely and did not appear to have much style. The upper part of the body was enclosed in a sort of blouse like our young boys wear on Earth. The trousers looked like knickers, but went down to the ankles.

"While we were still gazing enraptured at these strange marvelous beings, we suddenly became conscious of our brains being filled with a wonderful sort of music which seemed to originate inside of our heads. Instantly, the Martians who had stood around in a haphazard manner, formed a lane, the center of which was formed by ourselves. At the one end we now perceived a colossal bewildering structure with a church-like appearance which seemed to turn around slowly on its axis. When its ponderous portals, measuring at least 200 feet in height, had swung around so that they pointed in our direction, the structure ceased revolving. Immediately the portals slid back and out stepped a distinguished looking Martian, taller even than his brothers. He was dressed like them, the only difference being that his metallic cap appeared yellow in color. Otherwise there seemed to be no difference in his attire.

"At a gesture two Martians stepped forward to us and taking off our headgear replaced them with the soft metallic caps. By this time the distinguished looking Martian had come up close to us and stood still, but five feet away. He next placed

*†Jean Joseph Leverrier, a French astronomer, on Aug. 31, 1846, in a paper to the Ecole Polytechnique, declared that he had computed the orbit of a supposed new planet still further removed than Uranius, the latter then thought to be the last planet in the solar system. Not only did Leverrier predict the new planet, but he also predicted it to be a star of the eighth magnitude. Most wonderful of all, however, he actually indicated where this new planet should be located in the heavens, and he asked that astronomers should look for it there. This Galle of the Berlin Observatory did on Sept. 23, of the same year, and he found the new planet within less than 1° from the spot indicated by Leverrier, *who had never seen the planet himself.* Leverrier had based his scientific prophecy upon certain observed irregularities of the Planet Uranius, although Neptune is 2,654,560,000 miles away from the Earth—an enormous distance.†

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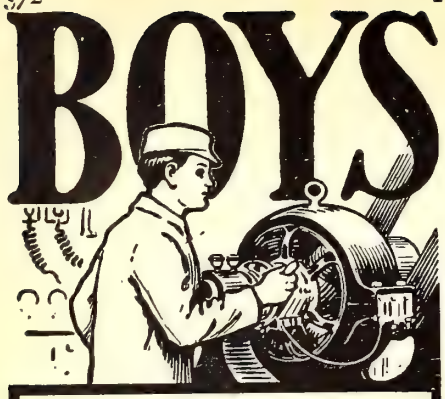
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(*Continued from page 371.*)

the tips of the fingers of both hands to his temples, which we took to be a salute. We hastened to respond likewise, but we must have executed the motion poorly, for a faint rather amused smile ran over the brownish features of the august Martian. He then turned around and with a motion some attendants bade us to follow the chief, which we did. He then entered the church-like structure and we followed him deferentially.

"Well, Alier, my boy, I guess the telegraphone wire must be almost full by this time. So I guess I will have to close for to-day. Now don't forget to listen in tomorrow night for there's a lot to be said about this wonderful planet. Good-night * * *."

A low rhythmic hum for a few seconds, then *click, click-click, click-click-click, click,* a snapping sound and the ether between the Moon and old mother Earth was undisturbed once more.

(*To be continued.*)

WIRELESS USED IN STARTING AUTO.

John Hays Hammond, Jr., has demonstrated that there is such a thing as wireless control from land of an object at sea, but it has remained for the Overland company to show that an automobile can be started from a distance by means of wireless telegraphy.

Proof positive came at the Indiana State Fair, where the motor of a Model 83 Overland was started every five minutes by a wireless spark from the Overland headquarters, five miles away in Indianapolis.

A complete wireless outfit—motor generator, transformers, relays and other paraphernalia—was installed in the show windows of the city salesrooms. This was connected with an aerial on the roof of the building, and by stepping the alternating current up from 110 volts to 16,000 volts the apparatus made it possible to send messages 300 miles.

The Overland car on exhibition at the fair grounds was fitted up with a receiving apparatus and the necessary automatic switches and relays for throwing on and off the electric current of the starter and magneto. An automatic switch was regulated so as to allow the car to run for 45 seconds, after which the magneto was cut off. The operation of starting the car was repeated at intervals of five minutes.

An interesting feature of the experiment was the fact that the entire operation of starting the car was accomplished without the aid of human hands.

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC.,
Required by the Act of August 24, 1912,
of THE ELECTRICAL EXPERIMENTER, published Monthly at New York, N. Y., for Oct. 1, 1915:

NAME OF	POST-OFFICE ADDRESS.
Editor, *H. Gernsback*	*233 Fulton St., New York*
Managing Editor, *H. Gernsback,*	*233 Fulton St., New York*
Business Manager, *M. Hymes,*	*233 Fulton St., New York*
Publisher, *Experimenter Publishing Co., Inc.,*	*233 Fulton St., New York*

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H. Gernsback, Editor.

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Sworn to and subscribed before me this 24th day of September, 1915. *E. D. Junior,*
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(My commission expires March 30, 1917.)



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SOMETHING ABOUT SELENIUM.

(*Continued from page* 320.)

operating an automatic motor starter, which is connected to a motor driving a five-horsepower dynamo, supplying a bank of incandescent electric lamps. The moment the cell is screened from the light the motor is stopped, and if the light is again allowed to fall upon the cell it completes the circuit, consequently putting the motor and dynamo in operation. Thousands of horsepower of electrical energy can thus be controlled just by a wave of the hand.

In Fig. 12 is illustrated a number of most interesting applications of the selenium cell (which were also shown at the aforesaid meeting) in conjunction with a battery and relay, used for starting and stopping a tiny motor, ringing a bell, firing a cannon, blowing a horn and lighting incandescent lamps.

In the early nineties Mr. Hammer designed a dirigible torpedo, which he has long ago described in several of his lectures on the selenium cell. The identical plan has recently been proposed by several parties for steering an "electric dog," etc. Mr. Hammer's device consisted of an arm protruding from each side of the torpedo, each arm carrying a selenium cell hermetically sealed inside a box and having a lens covering an opening in the rear, so that a searchlight of the vessel dispatching the torpedo could be thrown on the cell to the right or the one to the left, thus steering the torpedo to the right or to the left, so that it would attack the flagship which was constantly being blanketed by the other moving vessels of the fleet. The selenium cells were connected to a differentially wound relay connected with solenoids and a suitable battery, which turned the rudder and controlled the course or direction of the torpedo. The searchlight upon the enemy's vessels could not affect the selenium cells, as they would be exposed only at the rear of the containing boxes and would face directly toward the vessel dispatching the torpedo. The control of a torpedo could be maintained at a far longer distance with success by means of a searchlight and selenium cells than would be practicable by a torpedo controlled by wireless; there would also be less chance of interference and it would be far more reliable, efficient and economical. Mr. Hammer some years ago also proposed this method of control for a dirigible aerial torpedo and for dropping bombs therefrom, releasing them by means of the beam from a searchlight.

A number of ingenious methods for utilizing the selenium cell for seeing at a distance have been proposed, but none have as yet been worked out commercially. Selenium will undoubtedly play a very important part in some of the coming discoveries and inventions.

We are indebted to William J. Hammer, consulting electrical engineer, of New York City, for permission to utilize in this article certain copyrighted illustrations and descriptive matter taken from his book, "Radium, Phosphorescence, Fluorescence, Selenium, Ultra-Violet Light, etc."

LEXINGTON, KY., NATIONAL GUARD GET WIRELESSS EQUIPMENT.

Part of the equipment for the wireless station of the Kentucky National Guard arrived in Lexington recently. The plant will be erected on the Fayette National Bank building and is expected to have a range of 2,000 miles.

WHEN THE LIGHTS WENT OUT ON THE "BELLA."

(*Continued from page* 316.)

our last visits to the ship, the whole blooming bunch of us were nearly shanghaied out of the port of "Brotherly Love." This incident happened thusly:

All of the staff were down in the bowels of the ship busily engaged in clearing up grounds, our usual occupation, and the ship was supposed to leave the dock at noon. At 10 p. m. a movement was noticeable in the hold and at first this was not paid any attention to. However, a little later one of us ventured up to the deck hatch and, "man alive!" if we weren't scooting down the Delaware River as neatly as you please, headed for the ocean. Needless to say, it took about three shakes of a lamb's tail to cover the time period consumed in gathering our coats and tools together, and the captain then hailed a passing tugboat. We dropped over the side of the "fruiter" down a rope on to the tugboat's deck and shortly afterward were glad to set our feet once more on terra firma. No more hundred-legged, poison-spouting centipedes for us.

NEW WIRELESS TO HONOLULU.

The Government wireless station at the naval training station at Lake Bluff, Ill., was placed in operation recently, after a severe test which demonstrated that messages could be sent from there to Honolulu. The station is for the exclusive use of the United States Government and no commercial messages will be accepted. It will be utilized chiefly for the flashing of Government messages to the stations on the Panama Canal and San Francisco for the direction of the Pacific fleet and for relay to the Hawaiian Islands.



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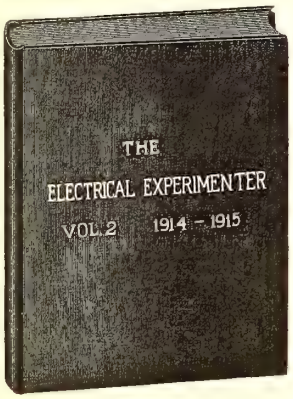
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RADIO FREQUENCY CHANGERS.

Of special interest was the paper on "Frequency Changers" read by Prof. J. Zenneck, of Germany, at the September meeting of the Institute of Radio Engineers, held at Columbia University, New York City.

This is one of the latest developments in wireless telegraphy and one that may revolutionize our present methods of obtaining radio frequency currents of large power.

The apparatus, as explained by Professor Zenneck, consists of two closed core transformers as shown in the figure. The primaries of the transformers P_1 and P_2, are energized by an alternator A. The winding B_1 and B_2 are fed from a direct current source B and included in the circuit is a coil L_1, possessing a sufficiently high inductance to prevent any induced A.C. from flowing in this circuit.

It is important that the corresponding windings on these transformers have exactly the same number of turns and that the cores be exactly alike in all points of construction.

The alternator supplies a current of 500 volts at a frequency of 10,200 cycles and the primary circuit is tuned to this frequency by means of inductance Lp and Cp.

The core is magnetized to ½ of its maximum flux density by means of the direct current winding. The A.C. serves to bring this up to magnetic saturation point.

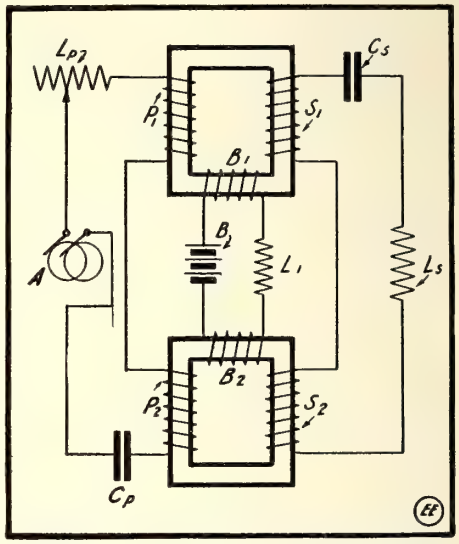
Under the above conditions the A.C. flux is superimposed on that due to the D.C. and the resulting current induced in the secondary has a higher frequency than the primary because of its peculiar wave form.

He showed that if the secondary windings are connected in series to oppose each other, the frequency resulting will be three times that of the alternator. This circuit is tuned by means of a capacity Cs and an inductance Ls.

Going one step further, the effects of connecting the transformers in parallel is to obtain a frequency just double that in the exciting circuit.

For satisfactory results, it is absolutely necessary to keep the alternator voltage constant after once adjusting the circuit to resonance. The speaker showed by graphic curves, that if the primary was de-tuned 3 per cent. the amplitude of the current in the secondary would drop to 25 per cent. of its maximum value.

An interesting point brought out in the discussion on this paper was the effect of eddy currents and hysteresis. The former were dropped from the calculations for by proper construction of the cores they would be reduced to a very small value. The effect of hysteresis was merely to increase the resistance in the primary circuit and did not effect results in actual practise.



Frequency Changer, Using Transformers Specially Arranged.

SEATTLE, WASH., RADIO TO BE EXTENDED.

Port Warden A. A. Paysee, at Seattle, Wash., has requested Mayor Gill to allow him a general public service license for the harbor department wireless, established recently at the port warden's office at Pier 1. At present the station holds what is known as a limited commercial license, and the local office of a steamship company is not permitted to send messages to one of its incoming ships. A general service license would allow the station to accept all such messages.

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UNDOUBTEDLY you have at the present time some things for which you have no further use. Do you wish to sell these things or exchange them for something, for which you have immediate use? There is no surer and quicker way to do this than by advertising your articles in these columns. The **Very** people, the **Only** people, who could possibly have a use for your things read this journal. More than 40,000 interested people will see your ad. It is furthermore the cheapest advertising medium for you in the country. Dealers' advertising accepted in Opportunity Exchange Columns only.

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The Classified Columns of "The Electrical Experimenter" Bring Positive Results.

FOR SALE—Gernsback interrupter. This instrument is in good condition, having been used very little. Two extra rods given free with it. Write for particulars to Robert Zimmers, 2822 Broad Ave., Altoona, Pa.

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FOR SALE OR EXCHANGE—Mandolin, guitar, Winchester 22, 1890 model repeater rifle, Korona 11, 4x5 plate camera and outfit, small lathe, bayonets, breech loading small caliber Belgian shotgun, dynamo meter for testing strength of back and legs, hand grip dynamometer; want screw cutting lathe, 110-volt A. C. motor, bicycle motor attachment, offers. C. O. Higrholzer, 224 Seeley St., Brooklyn, N. Y.

FOR SALE—Loose coupler, $3; ½ K. W. transformer coil, $4; ½ K. W. condenser, $4; helix, $1.50; electrolytic interrupter, $1.50; rotary gap (battery), $5; stationary gap, $1; energy indicator, $1. All highly efficient. Luther Reiner, Dexley, O.

FOR SALE—Football, 50c.; Remlugton single shot 22, $3.50; 1½ H. P. steam engine and bicycle. Write Raymond Bender, 147 S. Broad St., Waynesboro, Pa.

FOR EXCHANGE—Type E $150 Marconi receiving cabinet complete, also 1 K. W. high voltage transformer for complete or part of radio receiving set or Clapp-Eastham set of equal value or audion amplifier. John B. Hauley, Jr., 912 College Ave., Ft. Worth, Tex.

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FOR SALE—Small generator, direct connected to water motor. Generates 30 volts. Will swap. What have you? J. Forsht, Box 861, Lock Haven, Pa.

FOR SALE—Complete set of receiving instruments; never been used and not home-made. Sell at half price. For particulars write to Walter Metcalf, Lansing, Iowa.

FOR SALE—Banjo, No. 0 Brownie camera, Morse telegraph outfit, wireless receiving apparatus, motor and a number of story books. Send for list. Leland Epps, Oneonta, N. Y., R. No. 3.

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WILL exchange my extra high grade 2-inch spark coil, which cost $11 wholesale, for a 110-volt rotary spark gap of standard make and in fine condition. Will sell 110-volt motor, $3; peroxide of lead detector, $1; telegraph key, 50c.; 9 wet coils, $1; home-made electrolytic rectifier, 3-jar, $1; spark gap, 40c.; Willard hydrometer syringe, 75c.; Little Hustler motor, 50c. All in good condition. I might use a coherer and relay. Duncan Thomson, 318 Miles Ave., Billings, Mont.

PHONOGRAPH in good condition, 40 records, and Premo camera No. 0, will sell to highest bidder or for wireless goods. What have you? Karl Barnlag, 428 E. Leonard St., Grand Rapids, Mich.

MIGNON VARIO selective coupler, $4.25; Murdock 1,000-ohm single headset, $1.75. Francis Pray, 102 Heath St., Somerville, Mass.

FOR SALE OR EXCHANGE—Two E. I. Co. professional type loose couplers, $5 each; pair Brandes superior 'phones, $3.50; American model builder set, $4; one 2½-inch film tank, $2; one 4-volt 10-ampere hour storage battery, $2; one ¼ K. W. Packard transformer, $7; Ferron detector, $4; Murdock silicon detector, with condenser, $4. Want I. C. S. course in electrical engineering, audion detector or audion bulbs (good or broken). Henry W. Campbell, Ironton, O.

FOR SALE—1 K. W. wireless transformer with case, $15; 1 K. W. oil immersed condenser, $4; Impedance coil, $1; 1-inch transmitting set, $3; excellent portable receiving set, $12.50; coherer set, $2.50; Standard resistance set and many other things at bargain prices. Write for particulars and complete list. Allen E. Dudley, Milford, Mass.

BOOKS 3c. each, such as "Telegraph Tom," "King of the Gridiron," etc. For large list write Kenneth Woodward, 24 Lenox St., Uniontown, Pa.

FOR SALE—One complete I. C. S. electric lighting course, four bound volumes, good as new, cost $75; what offers? Address John Stokes, 7305 Denniston Ave., Swissvale, Pa.

WANTED—A second-hand induction motor of about ¼ H. P., 110 volts, 60 cycles, must be in good condition. John A. Irvin, Cannelton, Ind.

WILL sell E. I. transatlantic 'phones, $2.50; Mesco 2,000-ohm 'phones, $3.25; engine coil, $2; "Vesta" 6-80, $10. Carl Barnickol, 2317 Milwaukee Ave., Chicago, Ill.

HAVE 8-volt 80 storage battery, coil condenser gap, key sends 12 miles. Nichols coupler, condensers, galena and Ferron detectors, loading coil, variometer, 2,000-ohm 'phones, tunes 5,000 meters, receives 1,600 miles. 110-volt wireless telephone transmitter, bicycle, skates, skees and pole. Want Crystaloi, large spark coil, 6-volt, 60 storage battery, 3,000-ohm 'phones, or what have you? Ira Wright, Closson St., Methuen, Mass.

HAVE three ½-inch spark coils, loose coupler, variable condenser, loading coil; want Holtzer Cabot 'phones and crystaloi detector, or make offers. Harold Baker, 134 N. Church St., Waynesboro, Pa.

FOR SALE—One K. W. Hightone cabinet type rotary, $13; 1 K. W. Blitzen mounted transformer with protective device, $25; pair of Brandes navy 'phones, $10. Keane, 2936 Main St., Bridgeport, Conn.

FOR SALE OR EXCHANGE—1 pair of skees, No. 2 Brownie camera, $2 tuning coil, ¼-inch coil, ½-inch coil, static machine, boxing gloves, relay, two flashlights, two small motors, master vibrator, $5 worth of 25c. books, other electrical books. Want wireless goods, rotary gap, variable, transformer 'phones, books, 22 repeater rifle, or offers. Write L. H. Sargent, Abrams, Wis.

FOR SALE—1,500-ohm Murdock 'phone and headband, $2. B. Stanley, 405 Jersey St., Buffalo, N. Y.

FOR SALE OR TRADE—800-meter loading coil, galena detector, fixed and plate condensers, lightning switch. Will trade whole for Brandes 'phones, or what have you? B. Stanley, 405 Jersey St., Buffalo, N. Y.

FOR SALE—New 2,500-meter loose coupler, $6; ¼ K. W. transformer, $8 (range 25 to 50 miles); 1 K. W. helix and gap with 7 radiators, $4. Instruments in good condition. Harry McCarthy, Huntingdon, Pa.

FOR SALE—Two 1-inch spark coils, good as new, each $2.50; electro adjustable sending condenser, **$1.75; electro Tesla transformer, $3. Great bargain.** E. C. Braatz, Lowellville, O.

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Gentlemen:—

It may be of interest to you to know that I am now installing 2½ Kw. station at half price; about $25. This certainly proves the worth of your paper; I would not be without it. Two issues of it have saved me $24.80.

(Signed) Uriel Myers.

INTERFERENCE Preventer by A. L. Patstone. Reliable receiving instrument for aerials of not less than about 100 feet length, thoroughly rubber insulated, to exchange for audion set of no less value than $25, or what have you? Instrument rated to be worth $50 to $60. E. B. Nattenheimer, 555 Lexington Ave., Newport, Ky.

FOR SALE OR EXCHANGE—Electro's No. 9235 Detector, No. 8271 Helix, No. 9260 Condenser, No. 530 Condenser, ½-inch Spark Coil. What have you? Dean Wilson, Alpha, Ill.

FOR SALE OR EXCHANGE—Have full set I. C. S. Complete Electrical Engineering, also Remington 22 ga. 15-shot rifle (cost $10.50). Both like new. Want audion detector or bulbs, variable condensers or 'phones of equal value. F. J. Scupholm, 939 Court St., Pt. Huron, Mich.

EXCHANGE—Books, magazines, Shaw Engine, etc., for most anything; want electric motor, 38 reloading tools, or what have you? Box 322, Glasgow, Mo.

FOR SALE OR EXCHANGE—A I. K. W. transmitting complete, will send over 100 miles. Want $16 for set, which is in excellent condition. Will sell part of set if desired. Cecil Bridges, Louisville, Ill.

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Rosser, Man.

Please make 3 more insertions of my ad. as per enclosed clipping. **Results have more than exceeded my expectations.**

(Signed) J. L. GREEN.

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WILL exchange or sell at a bargain. All articles good as new. Interstate Receiving Outfit, double headset, static machine, X-ray outfit, 1½-inch sending outfit, etc. Write for list. Mark Biser, Middletown, Md.

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FOR SALE OR EXCHANGE—One 4x5 folding plate Seneca Camera. Would like to exchange for a good ½ K. W. Transformer Coil of reliable make. Winfred Slauson, Monticello, Ia.

FOR EXCHANGE—1½-inch Spark coil, 20-ohm sounder and key, telephones, polishing head, emery, buffing wheels, etc. Vest pocket Eastman Kodak. Other electrical apparatus. Want receiving instruments, or what have you? E. G. McCown, Spencer, Ia.

FOR SALE, CHEAP—I Omnigraph No. 4, 12 dials, auto spark coil, telegraph instructor. Write for prices. Oscar Eliason, Belmont, Ia.

FOR SALE—$35 Gents' Coaster Brake Bicycle, like new, sacrifice, $15. Alfred Theis, 512 E. 88th St., New York, N. Y.

FOR SALE—Ducks new 1915 Detector with silicon, 1 new rotary spark gap, never been used. All for $5 cash. M. H. Chapman, Baldwinsville, N. Y.

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FOR SALE—Experimenter's Electrical Apparatus, books and tools. Want to buy Shaw bicycle motor attachment cheap. Alex. Serna, Lehigh, Okla.

WILL sell for $8 or exchange for ½ K. W. Packard Transformer, a DeDion & Bouton motorcycle engine complete with spark coil, mixing valve, spark plug and timer. Edw. W. McClure, 3325 Hennepin Ave., Minneapolis, Minn.

WOULD like to buy an "Omnigraph and records." Oliver W. Mathewson, care Paine, Webber & Co., Boston, Mass.

AUTOMATIC Telegraph Transmitter, Giant sounder and key, Civil Service Course, History of the Railway Mail Service, Newspaper Correspondence Course, Insect Mount, Dividers. All for $2. Mark S. Kistler, Centerport, Pa.

EXCHANGE—Police .32 cal. Colt's revolver in good condition for a repeating rifle, camera, telescope, blue rock trap, or anything useful. James Gallagher, 1246 Fulton St., Brooklyn, N. Y.

WILL trade stamp collection 1,200 varieties, catalog value $60, for spark coil and other apparatus or cash, amount depending on size and condition of coil. Make offer anyway. Howard Peacock, Barker, N. Y.

DON'T STOP if you want to miss bargains. New wireless set, camera, motion picture films, mandolin, etc. Write for information. Kenneth Woodward, 24 Lenox St., Uniontown, Pa.

FOR SALE—One National Automatic Telegraph Transmitter with key, sounder, 27 records, containing over 10,000 words and Dodge's telegraph instructor. Outfit cost $20. Only 10 of the 27 records have been opened. Guaranteed as good as it was the day it left factory. Will take $10 cash. I. A. Gibson, Jr., 403 Bolton St. E., Savannah, Ga.

8-INCH spark coil, new, $50; 1½-inch coil, new, with spark gap and helix mounted, $5; sending outfit, 1½-inch coil high tension condenser, key, etc., $6; 800 mile receiving set, electrolytic detector, 1,000-ohm head set, fixed condenser, tuner, etc., $3. Brand new 5x7 Premo Camera, tank, chemicals, tripod, plateholders, etc., worth $45, price $30. I will buy or exchange for two to 20 pounds of D. C. C. or D. S. C. 36 copper wire, having fairly good insulation. Write Prof. Harry G. Starnes, Hillsboro, Ind.

WILL sell portable receiving set $5, cost $8; also several different size magnets. Want 1-inch spark coil, will pay cash. E. J. Bachman, 56 Fenwood Road, Roxbury, Mass.

FOR SALE—¼ K. W. $10 Packard transformer in best of condition; one K. W. Helix, value $4; spark gap, $2.50 platinum contact key, two condenser racks with plates and extra tinfoil, all for $11. Also 1,500-mile range receiving set at a reasonable price. Write me. Ellsworth Davis, Morrice, Mich.

FOR EXCHANGE—Bull's-eye kodak, 3½x3½ pictures, tennis racket, motion picture machine, 800 feet film standard size, electric Miroscope, 100 views of Florida, unwritten on. Wireless apparatus wanted. Russell H. Ford, 389 Tremont Ave., Orange, N. J.

I HAVE some electrical and sporting goods for sale or exchange. Write for information. Sherrill Halbert, Terra Bella, Cal.

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WANTED—3,000-Ohm Receiver and Variable Condenser. Must be in good condition. Write Joseph Kapinos, 115 Sweet Ave., Buffalo, N. Y.

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FOR SALE—Willard storage battery used five months. Perfect Condition. Just the thing for spark coils, motors, lights, etc. Cost $16, will sell for $9. Donald Curran, 66 Thorp St., Binghamton, N. Y.

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EXCHANGE—Small stock mail order goods worth $16 for wireless receiving set. Chas. Schively, 630 Liberty Ave., Brooklyn, N. Y.

FOR SALE—A Baker electric coupe in first-class condition with new batteries; three passenger. On account of illness of owner, will sell at bargain price of $500; cost new, $3,200. S. Gernsback, 817 West End Ave., New York City.

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SALE OR EXCHANGE—136 numbers of "New Tip Top Weekly" in excellent condition. Will sell at 3c. each, or exchange for numbers of "Brave and Bold Library." Samuel Olnhausen, 824 Chester Ave., East Liverpool, O.

FOR SALE—Several numbers "Electrical Experimenter," "World's Advance," "Modern Mechanics," "Popular Electricity and Modern Mechanics," one Morgan's "Wireless Telegraph Construction for Amateurs" and three handbooks, all going cheap. H. Frankland, 517 W. 113th St., New York City.

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FOR SALE OR EXCHANGE—One "Electro Junior" 2,000-ohm headset. In good condition. Edmund Blum, 715 Spring St., Elgin, Ill.

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EXCHANGE—20-ohm sounder and key. Want 1-inch coil or 2,000-ohm headset. Harry Thomas, Mound City, Mo.

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Vol. III Whole No. 32 CONTENTS FOR DECEMBER, 1915 No. 8

FRONT COVER—"A CANAL SCENE ON MARS"..... From a painting by Thomas N. Wrenn. —
RADIO LEAGUE OF AMERICA.....381-385
BARON MUNCHHAUSEN'S NEW SCIENTIFIC ADVENTURES.. By Hugo Gernsback. 386-388
HOW THE "WIRELESS WIZ" CELEBRATED XMAS..... By Thomas W. Benson. 389-390
BUYING BY MAIL. By Thomas Reed..... 391
TO FOIL SUBMARINES WITH UNDERSEA SEARCHLIGHTS... 392
BY WIRELESS 'PHONE FROM ARLINGTON TO PARIS..... 393
AUDION BULBS AS PRODUCERS OF PURE MUSICAL TONES.. By Dr. Lee de Forest. 394-395
THE UNITED STATES ADVISORY BOARD AND ITS PERSONNEL 398-399
THE ELECTRICAL BURGLAR OF THE 20TH CENTURY..... 400
A REMARKABLE ELECTRIC PIANO PLAYER FOR THE "MOVIES." By Frank C. Perkins..... 400
MARVELOUS ELECTRIC SIGN THAT ACTUALLY SPELLS..... 404
HIGH FREQUENCY CURRENTS AND APPARATUS (Concluded). By H. Winfield Secor, E E. 405
THE RADIO TRANSMITTING SET AT ARLINGTON, VA..... 406
UNITED STATES ARMY FIELD RADIO SET..... 407
LABORATORY EQUIPMENT FOR ILLUSTRATING THE PRINCIPLES OF ELECTRO-MAGNETIC, MAGNETIC AND ELECTRO-DYNAMIC PHENOMENA. By Harlan A. Eveleth.....414-415
HOW TO MAKE AN ELECTROLYTIC RECTIFIER..... By C. R. Barmekol. 416
A PERMANENT MAGNET TYPE VOLTMETER..... By Earle Belsinger. 417
"HOW-TO-MAKE-IT" DEPARTMENT..... 419
WRINKLES, RECIPES AND FORMULAS..... 423
"WITH THE AMATEURS" DEPARTMENT.....424-425
"LATEST PATENTS"..... 426
PHONEY PATENTS..... 427
OFFICIAL LIST OF LICENSED RADIO AMATEURS..... 428
OFFICIAL CODE CHARTS GIVING INTERNATIONAL RADIO SIGNALS, CONVENTIONS AND ABBREVIATIONS..... 429
"QUESTION BOX"..... 430
"PATENT ADVICE"..... 441
BOOK REVIEWS..... 446

Edison and Tesla

IF the recent cabled reports be correct, every American will note with great satisfaction the awarding of this year's Nobel prize in physics to Thomas A. Edison and to Nikola Tesla.

When Alfred Nobel, the multi-millionaire inventor of dynamite and nitroglycerine died in 1896, his will provided for a series of five annual prizes to the most deserving persons in physics, chemistry, medicine, literature and for the best work done in the interest of universal peace.

These prizes have been regularly awarded since 1901, and the learned Academies of Sweden while admittedly well informed and fair as to the award of the prize, have in the past, we believe, overlooked several scientists who by all means were entitled to the prize long ere this.

We are quite convinced, for this reason, that this year's choice of Edison and Tesla will not only be acclaimed in the United States, but in the world over. For, if the world is indebted to two physicists, Edison and Tesla are certainly the biggest single creditors.

The awarding of the Nobel prize in a single year to these two world renowned inventors naturally leads to the question: Who is the greater man, Edison or Tesla? A natural question such as this which surely will arise in the popular mind is manifestly unfair, because the two illustrious scientists have been working in dissimilar fields and their accomplishments are vastly different. Besides, Edison as well as Tesla are hard at work at this minute, and for that reason it is impossible to foretell what they might not still accomplish.

Without wishing to minimize Edison's tremendous amount of work, the fact is well known that he is not so much an original inventor as a genius in perfecting existing inventions.

In this respect Tesla has perhaps been the reverse for he has to his credit a number of brilliant as well as original inventions which, however, have not been sufficiently perfected to permit commercial exploitation.

If the average man were asked what Mr. Edison's greatest gifts to the world are, his choice probably would fall on the Incandescent lamp, the Phonograph and the Cinematograph. Undoubtedly this is a good selection, but it is but a small fraction of the 1,400 inventions which Mr. Edison has patented up to this date. The incandescent lamp would not have been much of avail to humanity had not Edison perfected at the same time the necessary adjuncts to feed the current to the lamp. He had to make dozens of inventions to accomplish this; the lamp itself was the least of his troubles. Exactly so with the phonograph and the cinematograph, several hundred inventions were necessary before either was ready to leave the laboratory. Thus it is a far cry and a weary road from his first tin foil phonograph record to his gold moulded unbreakable Amberol record.

Equally as great as the three above inventions are Edison triumphs in the field of telegraphy, which he revolutionized. His quadruplex telegraph, his telephone transmitter, his alkaline storage battery, his stock printer, his machine for separating magnetic ores, his Portland cement process, his concrete building standardization, are all inventions of the first order.

While Tesla's inventions have not been so numerous as Edison's the world nevertheless owes Tesla a tremendous debt. The modern transmission of power electrically is due entirely to Tesla. Perhaps his greatest invention is the alternating current induction motor, whose wonderful flexibility and vast usefulness have made electrical power what it is to-day. His pioneer work in high frequency currents showed the true genius of the man. This art is as yet but in its infancy and no one can foretell where it will lead us, but it certainly has already opened the way towards the transmission of power without wires. It is not popularly known, but the fact remains that Tesla invented a system of transmitting wireless impulses through the ether in 1893, three years before Marconi began his historical wireless experiments. His wonderful researches on vacuum tubes under the influence of high frequency Tesla currents have practically demonstrated that the day is not far off when the 95 per cent. of electrical energy now wasted in heat in all incandescent lamps will be turned into *cold* light, that is light without heat. In the long list of brilliant inventions of Tesla, we particularly wish to mention the following: His Sun motor for the utilization of solar energy, his new fluid propulsion turbine, the Tesla high-frequency coil, his rotary transformer, etc. Mr. Tesla's patents now number above 100.

H. GERNSBACK.

THE ELECTRICAL EXPERIMENTER is published on the 15th of each month at 233 Fulton Street, New York. There are 12 numbers per year. The subscription price is $1.00 a year in U. S. and possessions. Canada and foreign countries, $1.50 a year. U. S. coin as well as U. S. stamps accepted (no foreign coins or stamps). Single copies, 10 cents each. A sample copy will be sent gratis on request. Checks and money orders should be drawn to order of THE EXPERIMENTER PUBLISHING CO., INC. If you change your address notify us promptly, in order that copies are not miscarried or lost. *A green wrapper indicates expiration.*

All communications and contributions to this journal should be addressed to: Editor, THE ELECTRICAL EXPERIMENTER, 233 Fulton Street, New York. Unaccepted contributions cannot be returned unless full return postage has been included. ALL accepted contributions are paid for on publication. A special rate is paid for novel experiments; good photographs accompanying them are highly desirable.

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(Illustration shows container with cover off and battery partly inserted)

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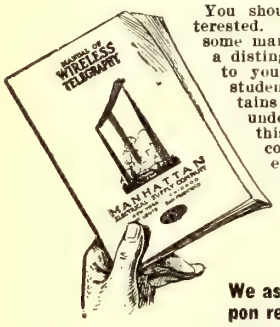
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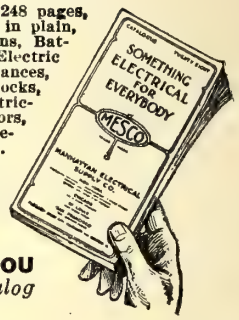
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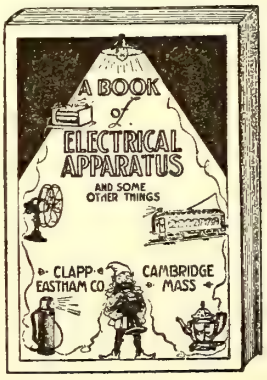
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THE ELECTRICAL EXPERIMENTER

H. GERNSBACK EDITOR
H. W. SECOR ASSOCIATE EDITOR

Vol. III. Whole No. 32 DECEMBER, 1915 Number 8

The Radio League of America

HONORARY MEMBERS

Captain W. H. G. Bullard, U. S. N. **Prof. Reginald A. Fessenden.**
Nikola Tesla. **Dr. Lee de Forest.**

Manager, H. Gernsback

A Retrospect.

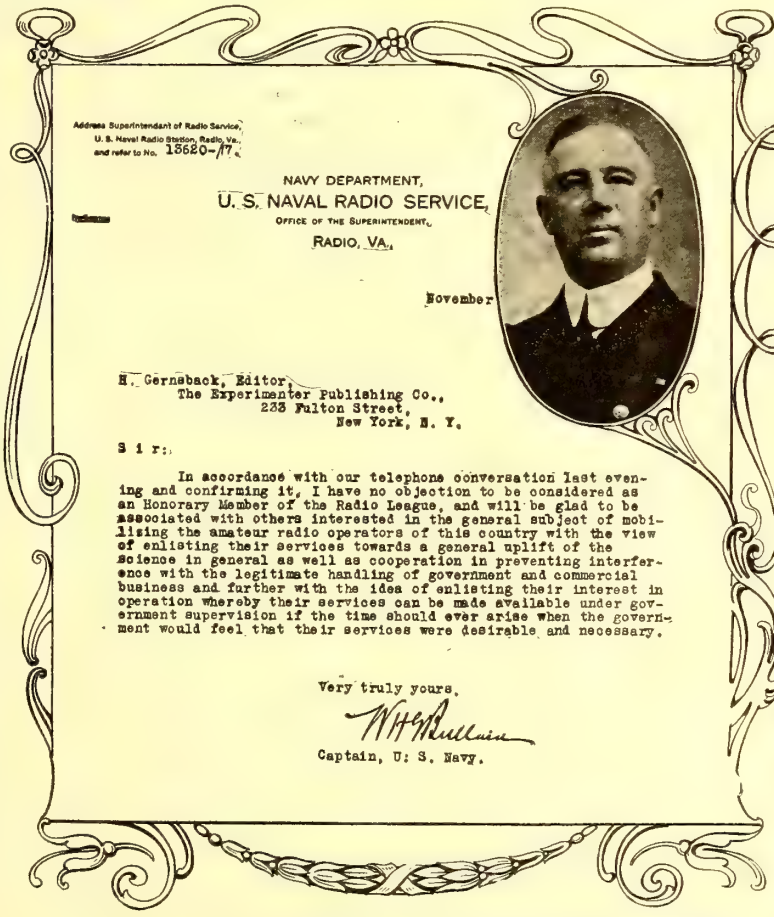
DURING the past year the need of a national body to champion the cause of the wireless amateurs in the United States has become more and more pressing. There are now over 300,000 radio amateurs and about 350 local clubs in existence in the United States, but there is no national body to safeguard the interests of the amateurs.

When H. Gernsback, in 1909, organized the *Wireless Association of America*, there did not exist at that time a wireless club in the United States. There were then, of course, numerous radio amateurs in this country, but the wireless art—as far as the amateur was concerned—was only in its earliest infancy. Mr. Gernsback, who at that time sensed approaching danger to the wireless amateurs in the form of hostile legislation, succeeded in banding together the majority of wireless enthusiasts, and the membership of the association grew rapidly till at the end of 1912 there had been enrolled no less than 22,300 members.

In those early days the wireless amateurs in this country were a rather reckless sort of element and became more and more disliked on account of their growing mischief. False distress and alarm calls by perverted "humorists" were the usual "smart" acts, and when a coastal station received a C.Q.D. call in those days the thought was always uppermost in the operator's mind that the call was one of the usual amateur hoaxes. Despite Mr. Gernsback's vigorous warnings through his editorials in *Modern Electrics*, of which publication he was editor, the mischief continued, till in 1910 several bills were introduced in Washington which fairly promised to throttle the activities of every wireless enthusiast in the country.

This, of course, brought the amateurs to their senses speedily, but had it not been for the formation of the *Wireless Association of America* a year earlier, all efforts would have been in vain and the amateur would to-day be as dead an issue as he is at present in Europe. Through the Association Mr. Gernsback caused thousands of letters to be written to Washington officials by the wireless amateurs, and he furthermore succeeded in enlisting the press of the country in taking up the cry to save the amateurs from hostile legislation. All this had the desired effect, and when finally in 1913 the Alexander Wireless bill, *amended*, was signed by President Taft, thereby becoming law, it contained almost word for word Mr. Gernsback's historical recommendation of his editorial in the February, 1912, issue of *Modern Electrics*. As is well known, that editorial called the attention to the lawmakers that in case the amateurs were to be restricted the latter should be allowed to operate their stations at a wave length below 200 meters, and they should furthermore be allowed the use of power up to one kilowatt. This suggestion saved the day, and the amateur at last had come into his own.

With the passing of the wireless act in 1913 the usefulness of the *Wireless Association of America* had come to an end, and thus matters rested.



Address Superintendant of Radio Service, U. S. Naval Radio Station, Radio, Va., and refer to No. 13620-/7.

NAVY DEPARTMENT,
U. S. NAVAL RADIO SERVICE,
OFFICE OF THE SUPERINTENDENT,
RADIO, VA.,

November

H. Gernsback, Editor,
The Experimenter Publishing Co.,
233 Fulton Street,
New York, N. Y.

Sir:

In accordance with our telephone conversation last evening and confirming it, I have no objection to be considered as an Honorary Member of the Radio League, and will be glad to be associated with others interested in the general subject of mobilising the amateur radio operators of this country with the view of enlisting their services towards a general uplift of the science in general as well as cooperation in preventing interference with the legitimate handling of government and commercial business and further with the idea of enlisting their interest in operation whereby their services can be made available under government supervision if the time should ever arise when the government would feel that their services were desirable and necessary.

Very truly yours,

Captain, U. S. Navy.

Captain Bullard's Letter of Acceptance as Honorary Member in the Radio League of America.

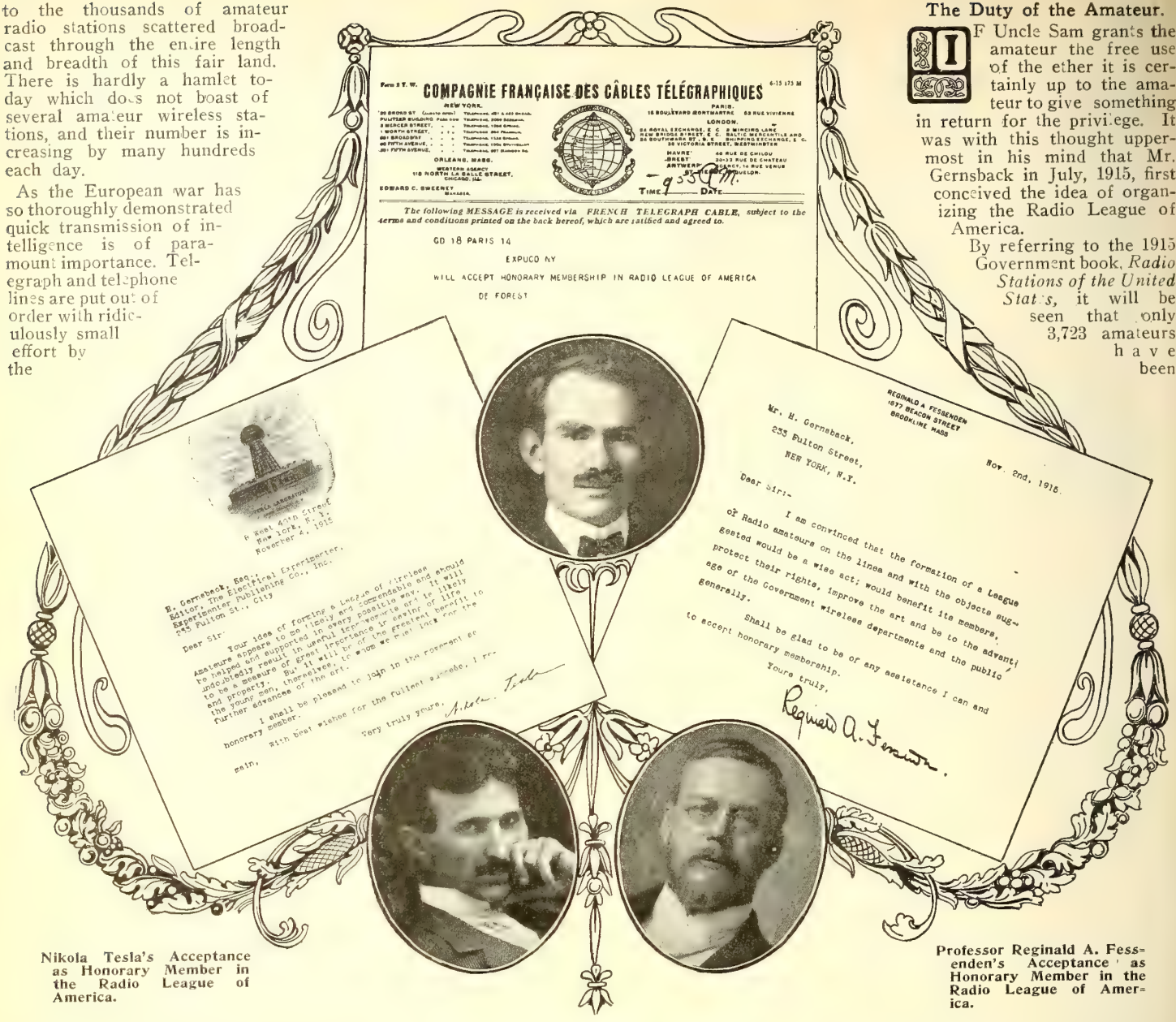
A Formidable Defense Weapon.

THE advent of the great European war in 1914 found the United States in an unprepared condition as regards its defenses and vigorous steps were promptly taken to wake us up from our lethargy. President Wilson's recommendation to the country for a vast increase of our army and navy has been so much discussed of late that no further reference to his valuable advice is required here. It suffices to say that probably a vast majority of citizens indorse the President's defensive military program.

But there exists to-day a formidable defense weapon, which up to now has not been exploited by Uncle Sam. We refer

to the thousands of amateur radio stations scattered broadcast through the entire length and breadth of this fair land. There is hardly a hamlet today which does not boast of several amateur wireless stations, and their number is increasing by many hundreds each day.

As the European war has so thoroughly demonstrated quick transmission of intelligence is of paramount importance. Telegraph and telephone lines are put out of order with ridiculously small effort by the



enemy and whole sections of country are thereby isolated. Such sections are then helpless and no important messages can be safely transmitted in either direction. All this helps the enemy enormously, and the thus isolated section is then entirely at his mercy. If France or Belgium had possessed an effective amateur wireless scout service there might possibly be a different story to tell to-day. In these days of fast military movements, quick reporting of war intelligence is of incalculable importance, and if this is true of Europe, it is even truer in the United States, the country of such vast and undefended coast lines.

One needs not be a dreamer in order to appreciate how easily a hostile fleet could approach our long, badly patroled coasts and try a landing of an armed force. There might not be a telegraph or telephone line around for miles, or if it did exist, it is certain that spies operating on land would have found little trouble in putting it out of commission beforehand.

But there will be a lone radio amateur on the alert who has seen the approaching fleet and within 30 seconds Washington will have the priceless intelligence. Vice versa, there might be a handful of poorly equipped United States militia holding the enemy at bay temporarily. It is conceivable that this small body of men might have neither sending nor receiving radio apparatus. Somewhere back of the hills the United States regulars are coming to the rescue of the sorely pressed militia men. They want the latter to hold out for a few short hours and want to tell them of their coming. The radio message containing this intelligence is flashed over the hills, but is not received by the exhausted men. However, just as all hope is given up, a lad of 17 years with streaming hair runs up to the major of the small band and breathlessly conveys the cheering news to him. He caught the message over his pitiful 30-foot aerial on top of his barn, but it saved the day. He did not even have a sending station. His outfit comprised only a cheap home-made receiving "set"! But it did the work, just the same.

Such occasions are almost certain to arise in the future, and it is thus of the utmost importance that every patriotic radio amateur should offer his station to his country.

Above: Dr. Lee de Forest's Acceptance as Honorary Member in the Radio League of America.

The Duty of the Amateur.

IF Uncle Sam grants the amateur the free use of the ether it is certainly up to the amateur to give something in return for the privilege. It was with this thought uppermost in his mind that Mr. Gernsback in July, 1915, first conceived the idea of organizing the Radio League of America.

By referring to the 1915 Government book, *Radio Stations of the United States*, it will be seen that only 3,723 amateurs have been licensed since 1913. The reason for this surprisingly small registration is found in the fact that the law does not require receiving stations to be licensed, nor small sending stations located in the interior of large States, where the effect of a weak spark coil would not extend over the State borders. Such stations are exceedingly numerous and have been estimated to run above 300,000. Now, then, there appears no reason for doubt that sooner or later the Government would pass a new law requiring the registration and licensing of such stations in order to have such stations available in case of national stress.

No one can foretell what surprises such a new law will bring the amateurs, and for that reason it cannot be denied that it is far better and more patriotic to give this necessary information voluntarily to the Government, instead of waiting till a new law is passed which might perhaps be detrimental from the viewpoint of the amateur.

The League's Charter.

THE Radio League of America was organized at New York under the laws of the State of New York in October, 1915.

Its charter follows:

CERTIFICATE OF INCORPORATION
OF THE
RADIO LEAGUE OF AMERICA, INC.

State of New York
City of New York } ss.:
County of New York

We, The Undersigned, of full age, citizens of the United States, a majority of whom are citizens of the State of New York and resident therein, being desirous of associating ourselves together for our mutual welfare and advancement, as hereinafter is more particularly described, pursuant to and in conformity with Chapter Forty (40) of the Laws of 1909 and known as the Membership Corporations Law, do hereby certify and declare as follows:

First—That the name by which the said corporation hereby to be formed shall be known and distinguished is and shall be *Radio League of America, Inc.*

Second—That the purposes for which the corporation is to be formed are as follows:

To promote the art of amateur wireless telegraphy and telephony in the United States among the members of the said corporation; to have available for the Government of the United States or any of its officials a complete list of all the amateur radio stations in the country pledged to the service of the Government for use in times of national danger or need; to establish a uniformity in the transmission of wireless messages by amateurs; to uphold the provisions of a law known as the Wireless Act of 1912 and all subsequent laws pertaining to wireless telegraphy; to assist the Government of the United States or any of its officials in apprehending offenders thereof; to prevent the sending of misleading wireless messages; to give information to the members of the said corporation concerning new and useful devices in the operation of wireless telegraphy and telephony and to provide an organization for the interchange of ideas concerning wireless telegraphy and telephony for the benefit of the members and the public at large.

Third—That the number of directors of the said corporation shall be and are five (5) in number; and that the names and residences of such directors who shall manage its concerns until the first annual meeting are as follows: (See below.)

Fourth—That the territory in which the operations of the corporation are to be principally conducted is the entire United States, and that its principal office shall be and is located in the Borough of Manhattan, City, County and State of New York.

Fifth—That the said corporation shall hold its annual meetings on the first Monday in October in each and every year beginning with the year 1916 (October 2, 1916), and annually thereafter.

In Witness Whereof we have made and signed this certificate in duplicate and have hereunto set our hands and seals this 25th day of October, 1915.

Hugo Gernsback, Sidney Gernsback, Milton Hymes, Harry W. Secor, Frederick H. Pruden.

As will be seen, the League is a purely scientific organization. There are no dues, no membership fees to be paid. It has been organized under the auspices of the world's greatest wireless men, who thoroughly indorse its principles. It is not a money making organization, nor is it conducted by a commercial wireless company for its benefit.

The *Electrical Experimenter* has been selected as the league's official organ, as this journal, with the largest circulation of any wireless publication at present, reaches either directly or indirectly almost every wireless amateur in the country to-day. It will publish the league's news from month to month, thereby keeping up the interest of its members.

The League's Rules.

EVERY wireless amateur of good standing, whether he has a sending or a receiving station, is eligible for membership. There are but two conditions:

1. He must be a citizen of the United States.
2. He must own either a sending or receiving station, or both.

Each member will be supplied with an official membership certificate furnished free by the Radio League of America. Our illustration gives a good idea of this beautiful certificate, but it must be seen to be fully appreciated. It is lithographed on a heavy bond paper in green and gold, and its size is 15x11¼ inches. The text follows:

CERTIFICATE OF MEMBERSHIP
TO THE
RADIO LEAGUE OF AMERICA.

A membership organization organized under laws of State of New York.

I, the undersigned, a radio amateur, do hereby apply for membership in the Radio League of America, upon the express condition that by so doing I do not assume or incur any liability either for dues, assessments or any financial obligations whatsoever, and, if accepted, I do agree to follow and abide by the rules and regulations of the league as set forth herein, and all other rules and regulations which may hereafter be adopted.

Rule 1. To observe all rules and regulations of the *Wireless Act* of 1912 (as set forth on the back of this certificate).

Rule 2. That I will at all times have my station in readiness and at the service of the United States Government for use in any defensive or offensive purpose in periods of war, riot or disaster.

Rule 3. That I will at all times allow my station and equipment to be used by the United States Government or any of its officials, and will assist, if possible, in apprehending offenders violating the Wireless Act.

Rule 4. I furthermore solemnly and distinctly pledge myself not to send out at any time whatsoever, a misleading call, particularly a distress call (S. O. S. . . . — — — . . .) nor knowingly allow another to use my station for sending out such a call.

Rule 5. That I will at all times, in case of necessity transmit a distress call to the nearest official, either by wireless, by wire, or in person, and that I will do everything in my power to bring assistance to the party or parties thus in danger.

Rule 6. That I will communicate to the League such information concerning the operation and construction of my radio station as will be helpful or instructive to the other members of the League.

Rule 7. That I will, when requested, furnish information concerning my radio station and observations, which information is to be used by the League in its compilation of wireless statistics.

Rule 8. That I will carefully read and adopt any suggestions published by the League for the benefit of its members, and the transmission of wireless communications.

Rule 9. That in case of my removal to another address, or in case of the permanent discontinuance of my station, I will immediately communicate such facts to the manager of the Radio League of America.

Rule 10. That I will display my membership certificate in the League in a conspicuous place in my radio station.

In witness whereof I have signed my name and address, etc.

Each certificate is numbered and a member is entitled to one membership certificate only. Before the League can furnish a certificate it is necessary that the prospective member shall fill out an *application for membership;* a convenient blank being printed below. (If it is not desirable to cut up the magazine, a blank will be promptly mailed on receipt of a 2c. stamp to cover necessary mail charges.)

No blank is valid nor can it be accepted unless it is filled out properly as prescribed. Two persons must sign as witnesses to the signature and these may be two friends, or your father and your mother, or a sister and a brother, etc.

Upon receipt of the application blank the official membership certificate will be mailed. Ten cents in stamps or in coin should be inclosed to cover mail charges, handling, as well as the heavy cardboard tube to insure safe delivery.

Upon receipt of the membership certificate by the member it must be signed at once in ink in its proper place, and it should then be suitably framed and hung up in the station in a conspicuous place.

It will give your station official recognition, and within the next few months the amateur who cannot produce an official membership certificate *will hardly be looked upon on a par with officially recognized amateurs.* He will have but little standing

Application for Membership in the Radio League of America

I, THE UNDERSIGNED, a Radio Amateur, am the owner of a Wireless Station described in full on the back of this application. My station has been in use since....., and I herewith desire to apply for membership in the RADIO LEAGUE OF AMERICA. I have read all the rules of the LEAGUE, and I hereby give my word of honor to abide by all the rules, and I particularly pledge my station to the United States Government in the event of war, if such occasion should arise.

I understand that this blank with my signature will be sent to the United States Government officials at Washington, who will make a record of my station.

Witnesses to signature: Name.....

..... City..... .....

State.....

..... Date.....191

Describe the apparatus of your station on the back of this application.

In the event of national peril, you will volunteer your services as a radio operator in the interest of the U. S. Government?.....

This last question need not be answered unless you so desire it.

NAVY DEPARTMENT,

U. S. NAVAL RADIO SERVICE.

OFFICE OF THE SUPERINTENDENT,

RADIO, VA.

H. Gernsback, Editor,

SIR:

I beg leave to acknowledge the receipt of your letter of November 8, 1915, submitting information concerning the *Radio League of America,* together with a copy of the Certificate of Membership.

It seems to me that you have undertaken to carry through a very patriotic motive in banding together the great number of amateur wireless operators in the United States, which, as you state, now number probably over 100,000, of which only about 3,000 have been licensed; it being presumed that the remainder operate receiving stations only, and under the law are not required to have licenses. This latter proposition I regard as a very serious detriment to the proper government control of wireless stations, and am of the belief that legislation should provide that all stations, whether for transmitting or receiving, should be licensed by the Federal Government. Although the Radio Act provides penalties for divulging any information received by means of wireless receiving circuits, yet the fact that important government messages might be received by unscrupulous amateurs not friendly to the home government renders some form of protection necessary, and, I might add, will be advocated this coming Congress.

The Naval Radio Service is particularly anxious to increase its operating personnel in time of public peril when many private stations, ship and shore, would probably be taken over by the general government, and the thought has arisen that through co-operation with the *Radio League* many of its members would like to enroll themselves for active service under the Navy Department at such times as their services might be required.

You can readily understand that any information collected by the Radio League will be of the greatest value to this service and this office will be glad to avail itself of your kind offer to furnish such free of all cost, this to contain the names, locations, etc., of all amateurs in the United States.

I should like further to take advantage of this opportunity to ask your co-operation in enrolling members of the *Radio League* for government (Navy Department) operation in time of war, and take this opportunity to enclose a circular prepared in this office which we have sent out to operating wireless companies in the United States, who in turn have distributed them to their operators, with the result that many civilian operators have engaged themselves to enlist in the Navy in time of war. Could we not do something similar to enlist members of your *League,* and would you lend your efforts to co-operate along these lines by giving the matter a little publicity? From the monthly list you propose to furnish we can get the names and addresses of many amateurs, among whom we might find many who would wish to enroll themselves. Of course, the forwarding letter accompanying the circular would have to be modified, but that could easily be done to call the attention of amateurs to how they can really serve their country in time of need.

Please accept my thanks for thus being allowed to bring to your attention certain views in connection with the *Radio League,* an organization which can be made to be of the utmost help to the government, and by focusing the attention on existing laws bring home to every amateur the desirability of co-operation all along the line to correct the great question of interference with proper government, commercial and other legitimate correspondence handled by means of the wireless art.

Very truly yours,

(Signed) *W.H.G. Bullard,*
Captain U. S. Navy,
Supt. Radio Service.

---

as a wireless amateur, for he obviously refused to pledge his station to his Government.

Privileges of the League's Members.

INASMUCH as the League has been organized for the benefit of the wireless amateur, its members are entitled to the following privileges:

Introduction to other members.

All members are registered on cards at the headquarters of the League. The names are filed geographically by State and town. Let us suppose you live in Plattsburg, O., and that you own a wireless receiving outfit. You very much desire to know several radio amateurs in your vicinity, but you have no means of making their acquaintance. As a member of the League you mail a letter to headquarters asking for the names of any wireless amateurs located in your vicinity. Such information will be given free to members, providing a two cent stamp is inclosed with the inquiry to cover postage. As a member of good standing in the League the other members will receive you gladly, and the future relationship between you and these members depends entirely upon yourself. Thus the League will be highly instrumental in bringing together members and cementing their friendship.



The League's Official Button.

Associations and Clubs.

A LOCAL wireless association, or radio club, to be officially recognized by the League must have at least six members. There should be a president, a treasurer and a secretary. The address where such a body meets should be stated. Clubs and associations should meet at least once a month. The above requirements are necessary to secure publication in the *Electrical Experimenter,* as well as recognition in the "Radio League of America's Official Year Book."

In this book, to be issued once a year, will be found all the important League news, a full listing of all the clubs and associations, as well as a complete list of all the members.

The League particularly indorses and encourages the rendering of scientific lectures by their members. The latter should write scientific papers, particularly those that have a wireless subject as its theme. The president of the club should select the best paper in his opinion, and it should be sent then to the editors of the *Electrical Experimenter.* If it has sufficient merit it will be published in due course in the *Electrical Experimenter.* It will show the title of the author as well as a sub-title, giving the name of the club to which the author belongs.

Once a year the best paper from among those that were published in the *Electrical Experimenter* will be selected by the editors and this prize paper will be published in the official year book. This honor will only be accorded to one paper.

Official League Insignia.

AN official button securable only by the League's members is illustrated herewith. This distinctive, as well as striking, design measures ¾ inch in diameter. It is inlaid in real, hard enamel in the three national colors, red, white and blue. The aerial design as well as the mast is in gold on a dark blue background. The button is heavily gold filled and is guaranteed by the makers not to tarnish for two years. It will positively not turn brassy. You will be proud to wear one of these distinctive buttons.

The League furnishes the button at cost; the price, including mailing, being 20c. Both the membership certificate and the button will be sent for 25c. prepaid.

A solid gold button as described above is furnished for $2 prepaid to those not desiring a gold filled one. The solid gold button and the membership certificate will be furnished for $2.05 prepaid, the actual cost of both.

All communications should be addressed to

THE RADIO LEAGUE OF AMERICA,
233 Fulton Street, New York City.

Description of My Station and Apparatus

Sending .....

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Receiving .....

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(OVER)

CERTIFICATE OF MEMBERSHIP

TO THE

RADIO LEAGUE OF AMERICA

A MEMBERSHIP CORPORATION
ORGANIZED
UNDER LAWS OF STATE OF NEW YORK

RADIO LEAGUE OF AMERICA

Honorary Members

Dr. Lee De Forest — Nikola Tesla
Dr. Reginald Fessenden — Capt. W. H. G. Bullard

I, the undersigned, a radio amateur, do hereby apply for membership of the RADIO LEAGUE OF AMERICA, upon the express condition that by so doing I do not assume or incur any liability either for dues, assessments or any financial obligations whatsoever, and if accepted, I do agree to follow and abide by the rules and regulations of the LEAGUE as set forth herein, and all other rules and regulations which may hereafter be adopted.

Rule 1. To observe all rules and regulations of the Wireless Act of 1912 as set forth on the back of this certificate).

Rule 2. That I will at all times have my station in readiness and at the service of the United States Government for use in any defensive or offensive purpose in periods of war, riot or disaster.

Rule 3. That I will at all times allow my station and equipment to be used by the United States Government or any of its officials, and will assist, if possible, in apprehending offenders violating the Wireless Act.

Rule 4. I furthermore solemnly and distinctly pledge myself not to send out at any time whatsoever a weakening call, particularly a distress call (S O S. ···———··· nor knowingly allow another to use my station for sending out such a call.

Rule 5. That I will at all times, in case of necessity, transmit a distress call to the nearest official, either by Wireless, or in person, and that I will do everything in my power to bring assistance to the party or parties thus in danger.

Rule 6. That I will communicate to the LEAGUE such information concerning the operation and construction of my radio station as will be helpful or instructive to the other members of the LEAGUE.

Rule 7. That I will, when requested, furnish information concerning my radio station and observations, which information is to be used by the LEAGUE in its compilation of wireless statistics.

Rule 8. That I will carefully read and adopt any suggestions published by the LEAGUE for the benefit of its members, and the transmission of wireless communications.

Rule 9. That in case of my removal to another address, or in case of the permanent discontinuance of my station I will immediately communicate such facts to the Manager of the RADIO LEAGUE OF AMERICA.

Rule 10. That I will display my membership certificate in the LEAGUE in a conspicuous place in my radio station.

In witness whereof I have signed my name and address this 16 day of Nov. 1915

Name [signature]

Address 1915

State

Manager Radio League of America

1603

The Handsome Membership Certificate of the Radio League of America Engraved in Green and Gold. The size is 15"x11¼". Every member is assigned a number.

Baron Münchhausen's New Scientific Adventures

By Hugo Gernsback

ONE of the greatest puzzles our astronomers and scientists had to contend with during the last decade is the problem of how water is moved in the Martian "Canals." Nearly all scientists of note who have studied them do not question their existence, but they are all at odds as to what agency moves such enormous quantities of water. It is singular that most of them suggest a form of pump to move the water in the canals, as our present-day knowledge of science and mechanics leaves them no other choice.

But what makes our rivers flow on Earth? What agency condenses billions of tons of ocean water and brings these waters down in form of rains, which keep our rivers from drying up? The Sun, of course. Why can't the Sun move the waters in the Martian Canals also? This instalment contains a new idea, how the Martians might accomplish it.

Münchhausen is Taught "Martian"

PUNCTUALLY, as always, at exactly 11 P. M. the next evening, Münchhausen's dear old voice once more sounded in my receivers. There was the usual preliminary talk, after which the Baron went on:

"I am very much pleased, my dear Alier, that my Radiotomatic relay station on the Moon works so well. Up to last night neither Flitternix nor myself were sure if we could bridge the 60 million miles between Mars and the Moon by wireless, but by means of our wonderful ultra sensitive radio-active detector we were enabled to 'listen in' successfully. When I had finished talking last night, it was about 9 P. M., your terrestrial time. We got our receiving instruments ready at once and promptly at 11 P. M. *I could hear myself talking.* The message which I had sent a few hours before had been faithfully recorded on the telegraphone wire of my Radiotomatic on the Moon, and as soon as the automatic clock released the sending machinery, the vibrations carrying my voice were hurled back to us over a distance of 60 million miles. From this we knew that you must have heard the message too, for you are but 238 000 miles distant from the Moon. While my 'canned' voice undoubtedly must have sounded uncanny to you—excuse the pun—I assure you that it gave me the creeps listening to my own voice, flung 60 million miles through the ether!

"But to come back where I broke off last night: I told you how several Martians had approached us and had placed a soft metallic cap on our heads. I also told you how we then followed the august Martian into the church-like structure.

"While we walked over the hard metallic-appearing walk, which conducted us to the structure, we became conscious of strange flashes in our brains. We also caught distinct, though faint, bars of a soft music, which was followed by weird pictures flashing through our minds. All this took place within our heads, and as I closed my eyes for a few seconds to test myself, the music as well as the picture flashes persisted; I knew then that I did not hear the music with my ears, nor see the pictures with my eyes. I reasoned correctly that both had their origin within my brain.

"Before I had time to puzzle it out, we had entered the structure at the heels of our host. We passed through a magnificent archway, constructed entirely of some transparent material, decorated in superb taste in green, white and gold. One thing struck us immediately; the hallway appeared as light as day, but we could not see where the light originated. Later, though, we were to find out about this.

"As the end of the hallway was a ponderous massive panel with a door-like appearance. It must have been at least 125 feet high and 30 feet wide. It looked very much like cut glass with all its prisms and fancy cuts; we first thought it was glass, but when we came closer to it we changed our minds, for we saw that the huge thing was as flexible as a velvet portière. When our host was but 10 feet away from it, it suddenly blazed forth in a brilliant golden light which seemed to come from nowhere. Simultaneously the huge door, for this is what it was, rose quickly up in the air just like a theater curtain. Our host now entered into a large circular salon-like room, followed reluctantly by us.

"I say reluctant advisedly. I have absolutely no adjectives to do the thing justice. Our state of mind upon entering that room was probably the same as if you had brought back to life Julius Caesar of the year 50 B. C., and had suddenly transplanted him some night on blazing Broadway in New York. His mind would have reeled at the—to him—marvelous sights. It would have taken him days and days of asking questions and explanations of all the impossible things he saw before him.

"Exactly so with us. Only Caesar would have made a jump of but 1,965 years, where we made one of over 200,000 years. We were but uncomprehending children, and our eyes and senses were absolutely inadequate to do justice at once to the higher plane of civilization on which we had been thrown so suddenly. We have been on Mars eight days now and still we know practically nothing of this most miraculous world. Every day brings more tremendous surprises and at night we are usually exhausted from all the excitement of the continuous bombardment of new and wondrous things on our brains.

"But to come back to the wondrous salon of our host, who, as we found out later, was the reigning Ruler of the Planet Mars. The house in which we were was a sort of executive mansion or palace, and the room in which we were standing was what you might call the Ruler's office.

"Here I must stop again to advise you that it is extremely difficult for me to explain in existing terrestrial terms what we see, hear and feel, for everything on Mars is so totally different from what we are accustomed to on Earth, that my best comparisons with terrestrial things must of necessity fall far short of actual conditions on Mars. However, I will do my best to convey a true picture to you.

"The thing that struck us with greatest force at first was that *everything* in this immense room appeared transparent. The room, which is about 150 feet in diameter, is about 60 feet high, with an immense golden transparent cupola forming the ceiling. The tables, the chairs, all the furniture, as well as all the objects for which we had no names, seemed transparent. Even the walls seemed transparent, as well as the soft, rug-like carpets on which we walked. But the wonder was centered not solely in the transparency of the strange material, but in the fact that it gave forth a soft, white light. Imagine a solid chair of glass, glowing in a mellow, white light—not a brilliant light—and you have a good idea what we beheld. It struck us at once that this wonderful material could be handled at will by the Martians; for, the luminous rugs on which we stood were soft as velvet, while a desk-like object nearby seemed hard as steel. The next thing which attracted most of our attention were the luminous walls. They were all paneled in a curious manner, and, of course transparent and luminous. Each panel had a vast amount of small hexagonal plate-like facets arranged somewhat in honeycomb fashion. These hexagonal cells were constantly changing in soft colors, and the most unique, as well as pleasing, geometrical designs in colors were thus unendingly produced. It was a fascinating sight, and we found it hard to take our eyes from these walls.

"At the far end of the room we noticed four Martians whom we recognized at once as females on account of their mass of hair and their more delicate features. Their heads seemed somewhat smaller than those of the males, but they appeared to dress exactly like the men, except that the color of their metallic looking dresses was of a much lighter shade. But it was not the 'girls' that drew our attention as much as what they were doing. We could not rid ourselves of the idea that these females were some sort of secretaries to our host, and it was manifest that they were 'working' at something. And they appeared to be working earnestly and diligently, too, but there were no pencils, no books, no paper, no typewriters; in fact, nothing whatsoever that a terrestrial secretary requires to get up her superior's reports.

"Instead each girl sat motionless in front of a small glass-like table which was entirely bare and flat, except for the center, from which projected two small glass-like rods each about 4 inches high and as thick as a pencil. At the top they bent over and formed a gooseneck pointing in the direction of the girls. The rods were both pointed at their ends, and while one appeared luminous, the other seemed dark.

"The 'operators' were watching the point of the luminous rod intently, and the expression of their faces was as if they were reading something. Every once in a while they seemed to relax and at that moment *a curious white ray seemed to pass from the light point of the rod into the point of the dark one.* That was all we could see.

"While we were still wondering our host motioned us to sit down on the comfort-

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able looking arm chairs. These chairs, as already mentioned, appeared like transparent glass, but when we put our hands on them they felt like satin and not at all hard or cold. The transparent seats, which had a moment before appeared as glass, were soft and flexible as an air-cushion and extremely comfortable. The only trouble with the chairs was that they were too big for us. Built for large 8-foot Martians, our feet hardly reached the floor, so we sat in the chairs just as children sit in big armchairs, that is with our backs resting against the inside back of the chair and our legs and feet projecting straight out on the seat; and only then were we quite comfortable.

"This position, ridiculous as it doubtless was, evoked a faint smile from our host, who sat down in his own chair in front of a large piece of furniture that was a cross between a rectangular table and a flat top desk, garnished in its center with a huge birthday-cake-like affair with 10 transparent and 10 dark glass-like candles, curved in gooseneck form.

"Our host then turned around to us and looked us over long and earnestly. His large, liquid blue eyes were wonderful in their depth; in them shone a wisdom as, indeed, we had never before beheld. His face had a very benevolent expression, and the features were clear and sharply defined. He appeared tremendously intellectual, yet will power and strength of character radiated from his face in an amazing manner. We thought at last that he was going to speak to us, instead he motioned to us to close our eyes, which, of course, we did. The following then took place, and I will describe it as well as I can. No sooner had I closed my eyes than a clear picture of the Earth with its continents was flashed in my mind, just as if I had tried to think intently of the terrestrial globe, as it stands silhouetted against a dark sky. Then in quick succession followed our 'Interstellar,' the Planet Mars, a picture of our capture by the Martians with their yellow rays and their floating fortresses, then an exact picture of how we appeared at our landing on Mars.

"It then dawned on us that our host was 'talking' to us, not in words and not in a strange language, but motion-picture-wise. *We had experienced the first transference of thoughts,* and had understood everything our host had 'said,' because he thought in pictures which were perfectly familiar to us, not in words which would have had no meaning for us! When there was a lull we opened our eyes in astonishment and blinked bewildered into the smiling eyes of our august host. He seemed highly amused at our amazement and once more he motioned to us to close our eyes.

"For the next hour or more we had our first lesson in 'Martian.' In easy stages our host first flashed simple pictures into our minds, which were then followed by scenes with various actions and explanations just as in a moving picture scene, where the mind must infer what the actors are saying to each other by the expression of their faces and their obvious actions.

"There was a short pause, after which our host launched into the 'Evolution of Mars.' We were first shown how the planet, millions of years ago, was but a nebulae floating in space and how the nebulae slowly became a solid sphere. The early life of Mars was then pictured, which must have been exactly like the evolution of our own Earth. We saw the prehistorical Martians with their clubs and stones, then we saw for a long period the slow evolution of Mars down through the ages till a civilization similar to that of present terrestrial conditions was reached. There were the wars, the barbarism and the thousand other evils exactly as those experienced by man on Earth. Evolution, after all, is the same throughout the Universe, given like conditions.

"As the story of the evolution went on we could see how the Martian's small head and his small chest both kept on increasing with each subsequent generation. We were shown how big oceans and inland seas, as well as vast rivers, dried up gradually, and how the whole population turned into mechanics, electricians and chemists. No true happiness and contentment, however, seemed to exist on Mars until thought transference was established, till gravity was conquered and money was abolished. There had been wars and disorders up to that period, but it seems that these three things, apparently invented and originated at about the same time, finally emancipated the race completely. As we found out later, this period was reached some 14,600 years ago.

"Beginning with that period only did the Martians really become great. We saw how in less than five generations speech had been entirely abolished, it being possible to 'converse' over considerable distances by thought transference. We were shown the evils of too many languages and the race hatreds produced thereby, and how finally one universal language was adopted by all races and nations. We saw the abolition of presidents and rulers over small and big nations, and the inauguration of a Universal Council and a Planet Ruler, both elected by popular votes.

"We witnessed how the once dense a

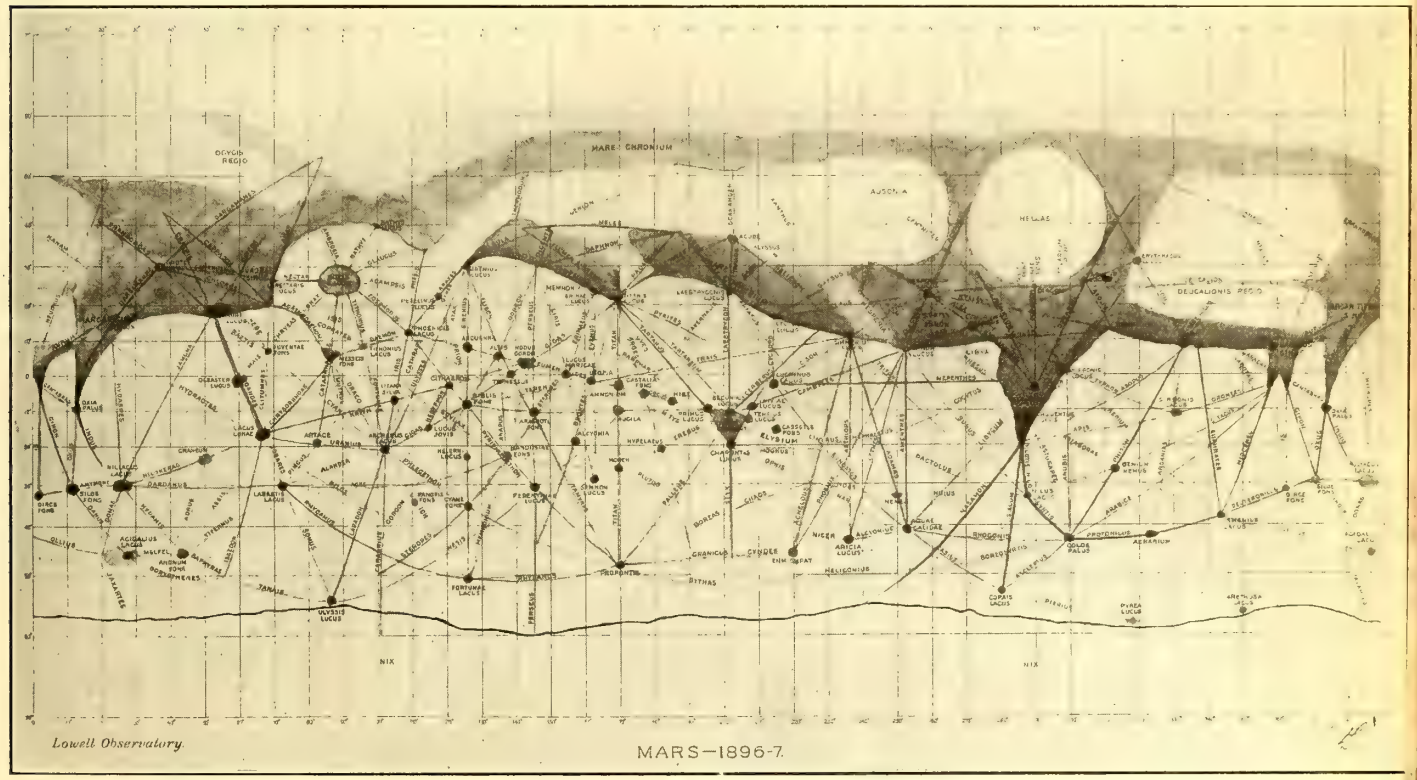


Photo courtesy Prof. Percival Lowell, Lowell Observatory, Flagstaff, Ariz.

The above map shows Mars and its canals in Mercator's projection. As objects appear upside down in the telescope, it should be remembered when studying the above map, that the top is South, the bottom North; East is left, West is right. Note how the majority of the canals run North and South (or South and North), toward the poles, which is necessary in order to convey the water from the melting polar snow caps equatorward. The canals can be plainly seen running over the dark areas, which are therefore not seas, but vast stretches of vegetation. Particular attention is called to the numerous circular dark spots, *only* to be found at the intersection of two or more canals. These dark spots, termed *Oases,* are thought to be circular vegetational tracts, containing vast farms, parks, cities, etc.

The above map was made by Professor Lowell at the last opposition of 1896-7 when Mars was but 40 million miles distant from the Earth. The white regions at the top and bottom are the snowcaps of the poles.

became thinner and thinner and how fertile valleys turned into deserts on account of lack of water. We saw the transmutation of the metals, as well as the transmutation of all other matter. Thus we were shown how iron or lead was turned into gold or copper, or into any other metal. Or else new marble or stone was turned into steel or gold or other metals, the same as clay can already be turned into aluminum on Earth to-day.

"Simultaneously with these discoveries, we witnessed the unlocking of atomic forces, which was the last great Martian discovery in the final mastery of the Planet.

"Where extermination had stared the Martians in the face on account of their constantly decreasing water supply, the new atomic engines, combined with the conquering of gravity, dispelled all fears for the future. During the next few generations we were made to see the creation of the monstrous waterways which not alone were to bring water from the two poles, but also were to irrigate existing agricultural districts as well as barren deserts. We saw how the Martians finally harnessed the Sun and how the latter was now moving the waters in the vast waterways, which you know as 'canals.'

"In quick succession we were then shown the past progress and evolution on Mars during the last thousand years. I do not attempt to go into details here, as you would surely not grasp the meaning. Neither do I attempt at this time to explain all the wonders that took place on Mars during the past 10,000 years, because you would not understand most of it, precisely as we did not grasp everything during our first 'lecture.' It therefore becomes necessary to explain the wonders to you by way of examples and comparisons with existing terrestrial terms. This I will do during our stay on this Planet.

"After our host had concluded his first 'lecture' he watched our utter amazement with the benevolent smile a fond mother will bestow on her four-year-old child after she has finished telling him a particularly interesting fairy story.

"After a short time we could understand him fairly well by his motions as well as by more picture talk without our eyes being closed. He then made us understand that he desired us to transfer our thoughts to him. Accordingly we tried the experiment. Flitternix's turn being first. He failed utterly, for our host shook his head smilingly. I then tried my hand, or rather my head at it. But as the metallic-like cap, which one of the Martians had placed on my head, made me too warm, I foolishly proceeded to take it off. Of course our host smilingly made me put it back again, and only then did I remember that he had shown us during our lecture that thought transference was impossible without the medium of the complex 'cap,' which I shall later describe to you.

"I then proceeded to concentrate my mind and began thinking real hard of Flitternix and how he appeared just then. For some seconds I did not seem to be successful, for our host looked blank. Finally, with the perspiration running down my forehead from the unaccustomed effort, the Ruler's face lit up and he pointed similingly at Flitternix! I was much elated over this success, *my first transmission of thoughts*, or rather *one* thought! For a few minutes our host then tried to make us understand that it would take some days of practise before we could hope to even 'talk' by pictures, and perhaps months before we could begin to actually 'talk' in words without using our tongues or ears. He then recommended that Flitternix and myself should practise as much as possible and to forget speech entirely. He also cautioned us that as all thought transmission took place through the medium of electricity, it was necessary that the flexible metallic cord hanging from our metallic-like caps should touch some conductor, preferably the ground. As we could easily guess that this was necessary in order to provide a return circuit for the currents we soon learned how to keep in contact with a conductor, when we wanted to transfer our thoughts from one to the other.

SYNOPSIS

I. M. Alier, an eccentric young scientist of Yankton, Mass., who claims as his own many new as well as startling inventions, far ahead of anything as yet discovered, owns the largest radio-telephone plant in the country. One evening he hears strange noises over his phones and immediately a sepulchral voice is heard. It is Münchhausen, one of the greatest yarn and story tellers of all times. **Münchhausen explains** how it came about that he did not die in 1797, as popularly thought, and he furthermore gives unrefutable proof that his home is on the moon at present.

Alier wants to know why Münchhausen went to the Moon and how. The latter then explains how Prussia persecuted him and how he went over to the Allies and succeeded in capturing Berlin in a wonderful manner. However, it was not a complete success, so the Baron left Europe for America. He immediately constructs a machine which is to take him into space to the moon. Münchhausen has discovered how to neutralize Gravity by means of Electricity, and he applies this invention to his space flyer, the *"Interstellar."* The machine proves a success; it responds and is lifted with tremendous speed towards the moon.

Queer things are discovered on the way to the Moon, among others that bodies lose all their weight inside of the *"Interstellar."* Finally a landing is effected on the Moon in a desert, but great hardship is encountered on account of the Moon's rarified atmosphere. The party then leaves for the nearest mountain range, where they discover a huge subterranean cave and a lake filled with luminous fish. **Bread trees are** also discovered. Münchhausen next gives a vivid description of the Earth, Sun and the firmament as viewed from the Moon; he also explains how the continents and oceans of the Earth appear from the Moon. He then tells of the ponderous meteors which continually crash down on the Moon. Finally one falls down near him and the resulting concussion hurls Münchhausen in a bottomless crater, which goes straight through the Moon. He falls clear through to the other side, but his momentum brings him back to the starting point, where he is saved by his companion. They then decide to depart for the Planet Mars, but they leave behind them an automatic Wireless Plant, the "Radiotomatic," which will relay the messages from Mars to the Moon and thence to Alier. A popular lecture on Mars is also given by Münchhausen.

Within 36 days they arrive at Mars, but when they attempt to land, three floating forts capture the "Interstellar" by means of a yellow ray which benumbs them, and guides the "Interstellar" to the Planet Ruler's revolving mansion where a landing is effected. Flitternix speculates on the probable appearance of the Martians and gives his reasons on which he bases his assumption. Immediately after landing, the Martians place soft metallic caps on the travelers' heads, and they are then conducted to the Ruler's mansion.

This story started in the May, 1915, issue. Back numbers will be supplied at 10c. each postpaid.

"As our host had to go to the other end of the room just then for a few minutes, Flitternix and myself tried thought transmission at once, and we surprised ourselves how well it worked. Not only could we 'talk' in pictures almost at once, but after a while we could tell each other whole sentences. Of course, the unusual strain gave us a headache long before our host returned, which was only to be expected; we had never been used to such hard mental work, and we understood quickly that we must learn the art gradually by constant slow practising and giving the brain a chance to recuperate from the strain.

"As if our august host had divined the strain on our minds during the past hour and one-half since our landing, he immediately began to divert us, and he did this admirably by letting us see for ourselves with our own eyes, instead of making us 'see' with our minds.

"However, we quickly began to understand and appreciate his wisdom in first giving us his historic lecture, because if he had not done this most of the things we saw during the next hour would have been meaningless to us. Thus you will understand that what I am going to tell you now, including the explanations, did not originate entirely in my own mind. Most of my explanations are, naturally, based upon that important lecture.

"We followed our host outdoors, where we boarded his private flyer. This machine was, of course, an anti-gravitational flyer, propelled by atomic engines. It behaved much like our own *'Interstellar'* that is, it had no wings, nor planes, because it is not dependent upon the air. The gravitational attraction of Mars is neutralized by the atomic engine to a certain degree. The more the gravity is neutralized the higher the machine rises. Now, in order to steer the flyer an *Emanation Ray* is used. This ray is the joint product of several elements not known on Earth; the nearest, although a poor analogy, is found in your Radium emanation, but the latter is several million times weaker than the Martian Emanation Ray. This ray is projected into space by means of electricity and another source of energy, which I shall term ION, as yet unknown on Earth, and to be described by me later. The Emanation Ray can be stored just as electricity is stored in a storage battery. When it strikes an immovable object it acts exactly as an oar does when the latter is used in 'pushing off' from a dock, i. e., the boat will move away from land. Precisely so with the Emanation Ray; it is used in controlling the horizontal motion of the gravity-neutralized flyer, and by its means the latter can be guided into any desired direction.

"Our flyer was round in shape, resembling a disc, and measured about 25 feet in diameter. It was almost 6 feet thick, and like most other things we had seen on Mars it was, of course, transparent. In the center was a dome that looked like the conning tower of a submarine, and a slender metallic pole extended from it almost 25 feet into the air. It branched out at the top into three short brackets, at the end of each was a transparent ball about 10 inches in diameter. Between these balls the Emanation Ray played, and the latter could be thrown at will into any direction desired.

"Our flyer was an open one and not covered on top, and there were two 'drivers,' which you probably would call chauffeurs, one forward and one aft. There were no steering wheels and no brakes, nor a horn. The two drivers sat in transparent chairs, not unlike our own, and in front of them was a little round table with small key levers like 'listening in' keys on an American telephone switchboard. That was all.

"As soon as we were seated, our host sitting between us, our 'drivers' pressed a lever or two, and we shot upward with amazing speed. In a few seconds the Emanation Ray went into action, and we began to fly or rather float into an easterly direction. From the position of the Sun, I concluded that it was almost 'Noon,' as the Sun was about overhead; this must

(*Continued on page* 442.)

How The "Wireless Wiz" Celebrated Xmas

By Thomas W. Benson

YES; I was burning the midnight oil, or rather *juice,* constructing a high-speed key for the "Wiz." I knew that he wanted this more than anything else and it had to be "some key." Time and money were no consideration, and neither was spared on this work of art. I was buoyed up to my task by the anticipation of the look on the Wizard's face when he would open the box and lift out the shining piece of apparatus on which I was spending so much time in making.

The noise I made in the basement was outdone by that in the ether, for my wrist was nearly gone, returning the good wishes of the season via wireless. In disgust I had shot the closing signal and slid away to the haunts of the rats and cobwebs. The clock in the kitchen had struck one, yet I ceased not.

* * * * * * * *

Time sped on, and that Saturday morning came at last, on which the world does honor to the birth of its Saviour. At six bells I kicked the blankets off and *sat in,* garbed only in my bathrobe and slippers, and nearly had the 'phones burned out by the disturbances in the ether which carried the good wishes that came literally pouring into the set.

I was the first one down that eventful morning and was waiting for the postman as he came whistling up to the door and fairly snatched the box out of his hand. I could not count the time in minutes or seconds that I consumed in opening the box; and, lo! a "wave meter" was revealed nestling in a bed of cotton batting. I reached forward to touch it, and—"ouch!"—I nearly dropped the whole thing. I grinned, for I had detected a soft, buzzing sound issuing from the box that explained everything. Using extreme care, and taking a few more shocks for good measure, I succeeded in getting the wave meter out of the box.

The "Wiz" had included a small but "hefty" medical coil and had arranged two clips that made contact as soon as the lid was removed. A few wires twisted around the box and one to the condenser had served to give me a *shocking surprise.* It was a wave meter that anyone would have been proud to own, and I knew the "Wiz" had spent some time in his "Lab." constructing it.

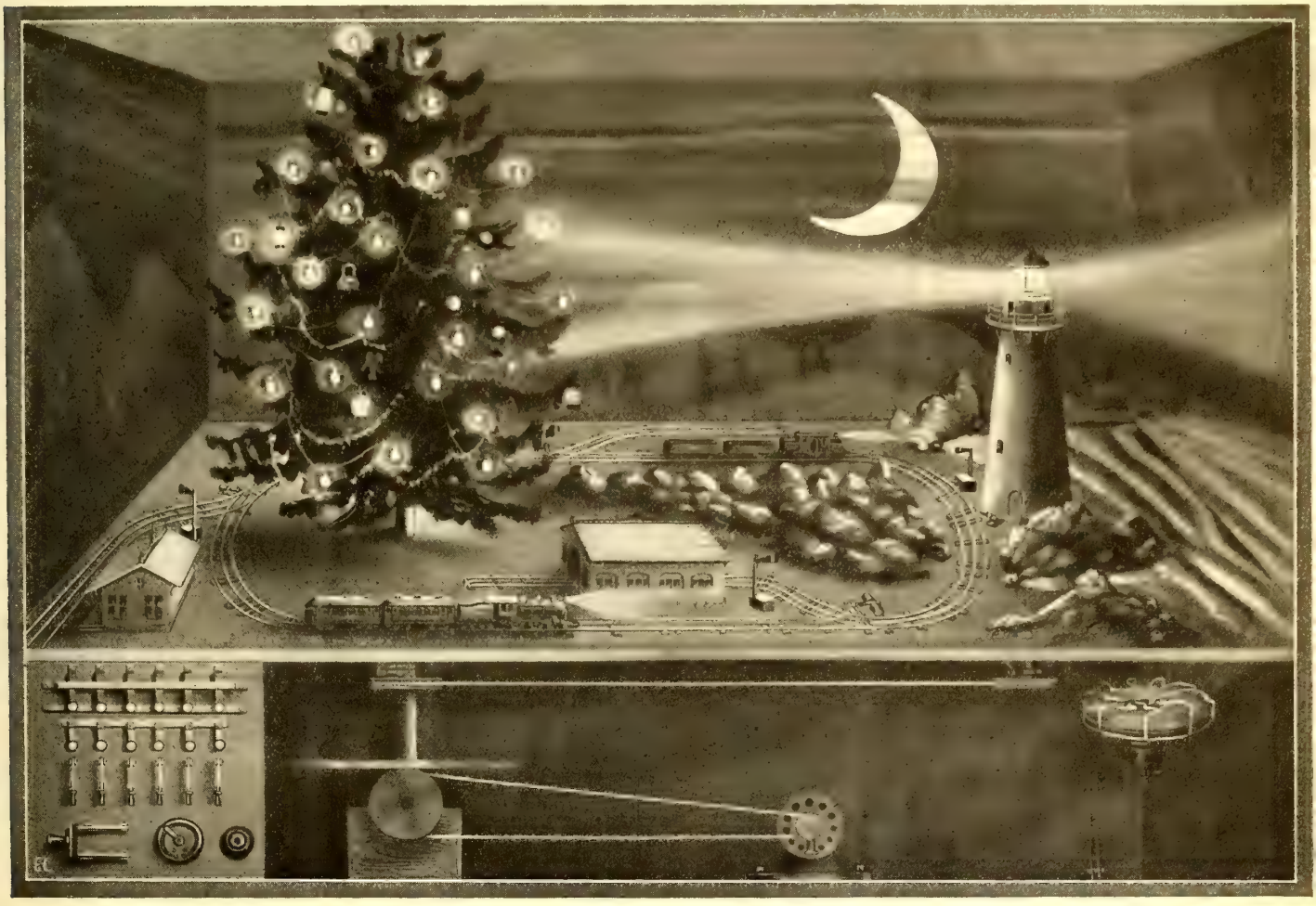
After I had eaten my breakfast I went out to call on him and, of course, bumped into the usual Christmas morning crowd roaming around half-dressed. They appeared to be waiting for the "Wiz" to start something, and as I came into the room he said, "You're just in time for the ceremony. I'm taking the kids in to meet Kris Kringle."

He stood in front of the door leading to the parlor *and clapped his hands.* The door swung slowly open, and to the strains of a Christmas carol, played on the Victrola, we walked into the land of wonders.

Wonder is a pretty poor word to express my sensation when I beheld the work of art the "Wiz" had wrought over night. The room was darkened, and half of it was taken up with a platform about two feet high and about six feet wide. On one end of the platform was a massive Christmas tree, slowly revolving, and at the other end was mounted a miniature lighthouse on the rocks, against which water appeared to be dashing. The platform was decorated to imitate a mountainous country in the wintertime, and over the whole scene hung a half-moon that vied with the ever-changing beams of light from the lighthouse for superiority.

On the edge of the platform were laid the gifts for the children, and with a shout of joy they dashed for them without waiting to pay any attention to the ever-changing, ever-flashing, vari-colored beams of light that made a charming scene; one indeed never to be forgotten. There was an electric curling-iron for the "Wiz's" sister, Olga. She left immediately with an abashed smile to try it out in the privacy of her own room. There was an electric chafing-dish for mother, and an electric shaving mug for dad, lying beside the usual collection of Teddy Bears and Trumpets that the kids were fighting over. I turned and saw them standing at the door with a smile that would not come off, and dad was feeling his jaw, to see if he was ready to test out the new shaving mug.

I looked for the "Wiz," as I wanted to compliment him on his work of art, but found him bending over a small switchboard, showing Joe how to dispatch the



The "Wiz" Had Quite Outdone Himself. A Miniature Lighthouse Blazed Forth, While Toy Electric Trains Passed Each Other True to Life. The Tree Revolved While the Lamps on it Blinked On and Off Repeatedly.

trains on the railroad system. After watching the action for a few minutes, I was practically speechless. He had laid out a railway system which consisted of two stations and a side-track. By closing a switch he would start a freight train from one station and simultaneously start an express train running in the opposite direction around the loop. It looked like a head-on collision, till he pressed a button, and the freight train would shoot on to a side-track and let the express through. After the express had reached the home station, the freight train would be backed off the siding and run to its station. This action could be changed indefinitely and many peculiar and exciting situations came up during the action. He would have the express train about to overtake the freight train when—click—the "freight" would be switched out of the way, with only two inches to spare.

The action was quite natural, for the trains would blow their whistles and emerge from the stations with headlights flashing, glittering on the imitation snow, and with a little stretch of imagination the beholder could readily believe himself on a mountain peak looking down at a scene in one of our many inlets in New England during the winter.

The tiny fir trees on the mountain side, the rising and falling of the semaphores, the whistling of the locomotives, all made such an enchanting scene that it was hard to realize that I was standing in a warm room in the city, and not seated on a mountain top, surveying a picturesque mountainous seashore.

The moon was the final touch to the scene as it shed its pale rays on the landscape, and casting faint shadows just like a real moon. Mountains were painted on the back scene, and the moon appeared to be just rising over the peaks. It was the kind of moon that jewelers and housefurnishing dealers delight in, being an accessory before the fact of many of their sales.

The only object that would spoil this flight of fancy was the Christmas tree slowly turning, while among its branches were flickering numerous tiny lights, and the colored rays from the lighthouse lit up the tinsel and shining fol-de-rols on its branches.

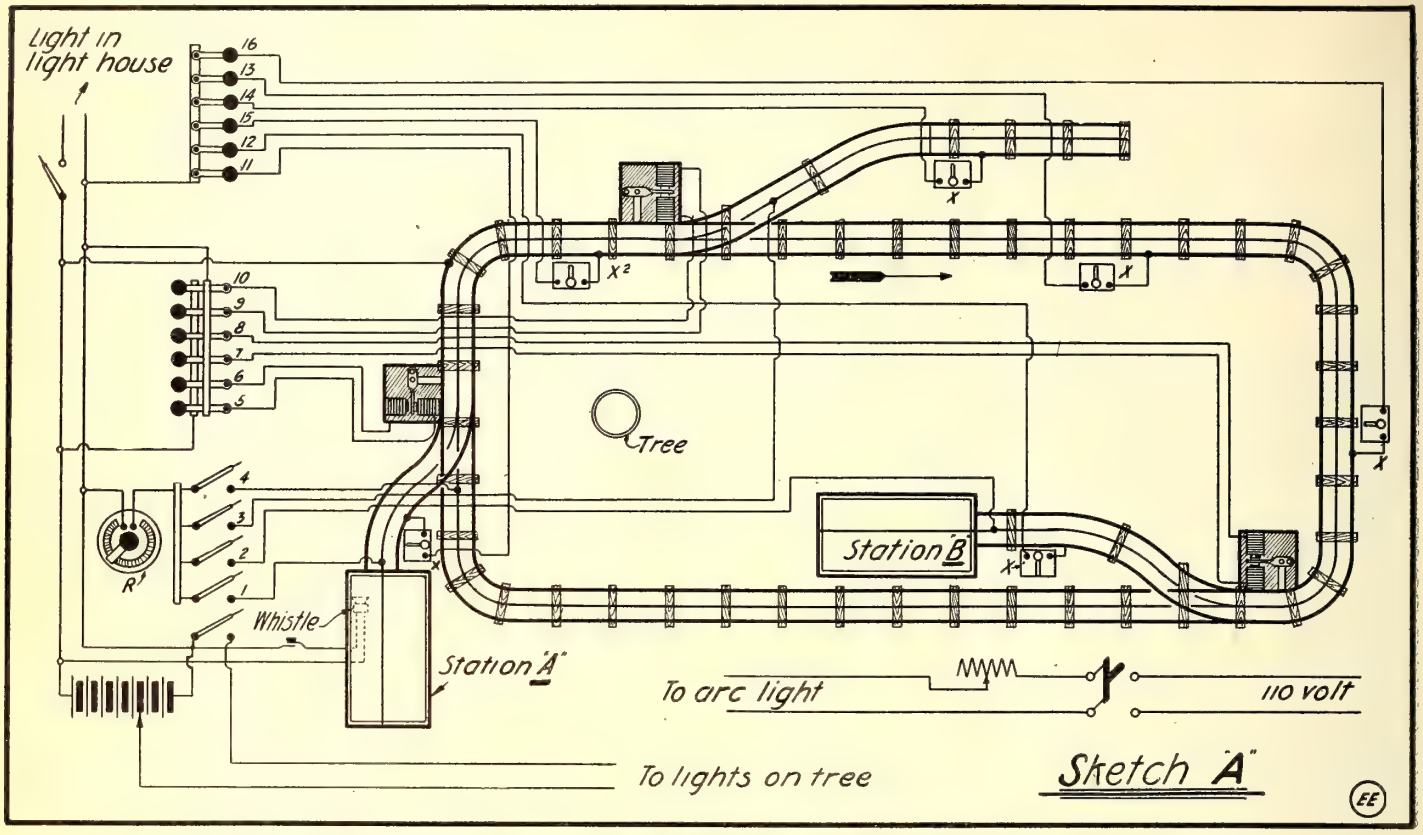
I have seen Christmas trees, many of them, but they all lacked something. Something was always missing, a subtle, but perceptible something that all things should possess when used in the worship of a celestial Deity. They had the gaudy appearance that oftimes means cheapness and lack of refinement.

This tree, however, was decorated very simply, yet did not look bare. It turned slowly on its axis, as though it were showing you, but not without a little hesitation, the wonders attached to its branches, proud of them, but endeavoring to suppress its pride.

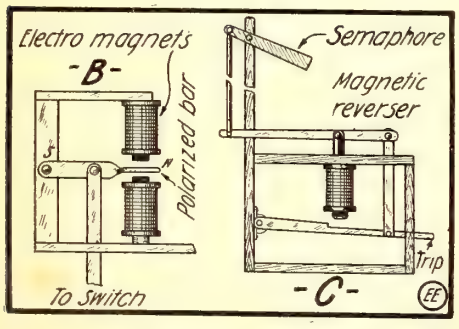
My attention was then attracted by the rocks on which the lighthouse was mounted and they appeared to be *glowing* in the semi-darkness. When the lamps in the lighthouse and tree were turned off and the moon had faded away to a faint glimmer, the rocks shone forth in the darkness in resplendent glory and the tree, revolving with its phosphorescent trimmings, put the final touch to the enchanting picture. Again the moon shone forth in all its glory, and the lighthouse once more sent its beams out to sea as I bade the "Wiz" farewell, to go my regular Christmas rounds.

As I left him I promised I would be back for the full details of this wonderful display, and asked him what he had received in the line of presents. With a half-depreciating smile, he replied, "Well, old man, outside of your high-speed key, I got a couple of pairs of slippers and a smoking cap, besides several boxes of those famous or, rather, infamous Christmas cigars. I haven't had time to open all the packages yet, though."

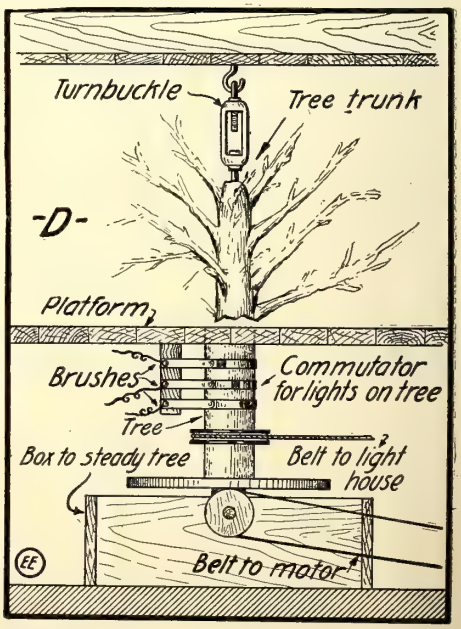
(*Continued on page 397.*)



Complete Layout of Toy Railway Tracking, With Automatic Reversing Switches, Side-tracks, Stations, et cetera.



Detail Sketches "B" and "C."



Detail Sketch "D," Showing Suspension and Base Mounting of Xmas Tree.

Buying By Mail

By Thomas Reed

I WONDER who the wise man was who first discovered that a boy's trade was worth having. As I look over the experimental supply catalogues of the present time—with everything that a "bug" could want pictured out so exactly, offered in the smallest quantities, and priced so cheaply—I am reminded of the humble figure we "old bugs" used to cut in the "marts of trade."

Those marts certainly bore us in no high esteem. It was a dreaded ordeal for us to meet the lordly hardware clerk and presume upon his august attention for five cents' worth of copper wire, or a quarter of a foot of brass rod. Our reception varied from an amuséd indulgence that made us afraid to come again, lest we wear out so kind a welcome—down through a snappish compliance that usually carried a crushing overcharge—down, down to the icy depths of "we don't deal in such small quantities."

How many times I have timidly inquired the price of some coveted material, such as copper burrs, to receive the answer: "So much a pound." A pound! A vast, uncertain quantity that would make me the envy of my fellow "bugs" in that one particular and bankrupt otherwise! The word "pound" gives me a shiver to this day.

And people never sold finished parts. "Oh, no," they said, "we're too sharp for that. If you could buy that one impossible piece, you would make the whole article, and we should lose a sale." Such was the logic of merchandising then. So the "boughten" commutator that we wanted to put the finishing touch on our home-made dynamo remained unbought. But what booted it?—as Shakespeare was wont to inquire. We found a substitute; and the stingy vendor, instead of selling a thousand commutators, sold no dynamos, or few, and disappeared from the haunts of men.

You lucky "bugs" of later times, take a day off and use it to realize your blessings. You can buy a single milled nut, or an inch of Wollaston wire, or ten cents' worth of galena crystals, and have them delivered at your door, and not grudgingly, but with a hearty "thank you; come again." And parts? "Why, sure; make all of it you can, and buy the rest from us." The best in the house is none too good for the amateur now.

The mail order! There can be great discoveries entirely outside of the physical sciences. The modern mail-order system is as truly an invention as the gas engine and, like it, was formed from several contributory sources. The development of illustration through the photographic half-tone and the machine-line engraving was necessary for the exact description of goods by catalogue. But another factor, intangible though it is, was requisite before the system could be a success—an insistence almost fanatical on the square deal.

It is greatly to the credit of the mail order that it lived down the errors of its youth. 'Way back in the '70s it was in decidedly ill-repute. The picturesque expression "Stung!" had not been added to the language, but the sting was certainly among those present in all advertising columns.

Those were the days of shin-plasters. Do you know what "suspension of specie payment" means? Say no, and say it with gratitude. Uncle Sam was paying his heavy war expenses in paper money, and Unc's gold and silver coinage had fled from the light of day. That's what economists call a necessary consequence, and you have to take their word for it; but I saw its inner workings. Whenever I peeped into the family strong-box I saw there a little roll of silver "quarters," hoarded since the beginning of the war, when the word went round that they would be "worth a premium."



" * * * It was a Dreaded Ordeal for Us to Meet the Lordly Hardware Clerk * * * to Purchase Five Cents Worth of Copper Burrs.

Mother had put them there, and I think her most reasonable hopes of profit took the form of a walnut chamber set. Mother was speculating. Dear old mother, she never speculated on anything else, except on the love and loyalty of her children; and sometimes, I fear, she must have placed those in the same disappointing category as the silver quarters!

So we used "fractional currency"—little young paper bills, about three inches by two, representing 50 cents, 25 cents, even 10 cents; and, believe me, even that humble form of money was hard to get. Boys had no "allowances" in those hard times—except the allowance to have nothing; but deep down in the boy-world there was a system of trade and finance. We collected rusty nails, swapped knives. Instead of stock transactions, we played marbles "for keeps"; though I assure you no dealings were permitted on margin. Well, this boy-wealth, accumulating as slowly and painfully as any other wealth, eventually blossomed into the small copper coin of the upper realm, finally to ripen into the glorified fruit of fractional currency. I have had the pleasure since of gazing upon a rather large banknote (not mine, to be sure—it was for $50,000, or such a matter), but it entirely lacked the haughty impressiveness of my first 25-cent shin-plaster.

And even while I gloated over my magnificent aggregation of capital, frenzied finance got it. I can see that seductive advertisement now, picturing a bewildering medley of articles—a printing press, a Japanese parasol, a trick spider, and a dozen other lures of childhood—all for exactly my fund of 25 cents. Wonderful coincidence, the chance of a lifetime. Really worth $1. Sell them for their real value and grow rich.

The old folks were sceptical—the Pacific Bank, it seems, had spoken in some such strain—but I knew better. Good-night, 25; a fond farewell! To New York it went, and for days I waited, each day a year long. With every rumble of a wagon I was at the window to see the express package trundled in. It was the postman, however, who handed out a box two inches by four—plenty large enough to contain a world of woe. Every article was there, *but in miniature form*—toys for a baby to suck the paint off, not goods commanding traffic in boy-commerce. The advertisement had not mentioned that detail. I was face to face with the dreaded "ketch."

I considered my young life blighted, of course, but it might have given me some comfort had I known that the mail order was blighting itself as well. It took a generation of time, strict laws, and the teaching of experience that honesty is the best policy before the mail order, in partnership with the square deal, came into its own.

You young "bugs" really don't fully appreciate how good the world treats you these days. No more "ketches" in these days of watchful post-office inspectors, no sir-e-e! When you stick your money order with your letter in the envelope, and send it off to that big mail-order house, you know just how long it will take till the postman hands you that pair of long-coveted "classy" 'phones. And, believe me, "bugs," those 'phones will be a whole lot better than the cut showed, or the description read. And on top of this, if you're finnicky and don't happen to like them, why of course you send 'em back. And in due time the mail order returns your money, if you want it.

Take it from an old "bug," you young "buglets" have lots to be thankful for.

The largest electric range in the world has been placed in the Montana State Hospital at Warren Springs, Mont. The range is more than 30 feet long. It is equipped with eight ovens and will prepare meals for more than 1,500 persons daily.

To Foil Submarines With Undersea Searchlights

THE submarine and mine constitute two of the greatest menaces to warships and other vessels under modern war-time conditions and to offset the utility and efficiency of same has interested many inventors both in this country and abroad. Inventors and scientists have advocated from time to time various methods whereby they hoped to render the submarine at least an obsolete engine of destruction.

What bids fair to be a successful combatant of these submerged terrors of the sea is the invention recently brought out by Prof. Herschel C. Parker and Edwin G. Hatch, of New York, mechanical engineer, associated with Prof. Parker in his engineering and research projects.

The accompanying illustration will give an adequate idea as to the method of utilizing this arrangement as perfected by Messrs. Parker and Hatch. Simply explained, it makes use of a powerful searchlight beam which is projected through a suitable focusing tube, fitted with reflecting lenses and mirrors and an instrument termed a *mariscope* (but really the same as the periscope used on all submarines) is used to sight through the water along the light beam, aforementioned, and which is turned about on the axis of the projecting tube until it intersects a hidden mine, the hull of a submarine boat, etc. When the mine, or other engine of destruction, is accurately located by this apparatus, the range of same, as well as the angle at which it lies from the hull of the war vessel, is measured accurately by scientific instruments, such as used on regular cannon. These angle and range figures are communicated to the gunner, who then discharges a special form of projectile resembling a torpedo. This projectile, of course, is so aimed as to strike the mine or other submerged devise, and it is not detonated until it is close to the submerged body proper. It is then exploded by the gunner, who closes an electric switch, causing a current to flow along the attached wires to the projectile, fusing a fine wire detonator inside the missile.

On first sight this invention may seem to be a mere theorist's dream, but from tests that have been made in the taking of pictures under water by means of a powerful searchlight, it is definitely asserted that submerged objects can be seen in this way for distances of from 1,000 to 2,000 feet. These distances, of course, may be greatly increased by using a proportionately greater amount of energy in the searchlight projector. The larger projecting tube, into which is fitted the searchlight lenses, mirrors, etc., is termed a *helioscope*, and the instrument mounted in the smaller sighting tube through which the submerged body is viewed is called a *mariscope* by the inventors. In the illustration herewith given it is, of course, to be taken into consideration that the proportionate distance between the mine and war vessel proper is quite close, but in practise the distance would naturally have to be greater than that shown, for the reason that the explosion from such a device would affect the vessel undoubtedly unless it was more than 300 feet away. If this device is actually tried out and adopted by the navy it would have to be arranged most probably in some such manner as our illustration shows, so that a protection would be afforded the gunner and sighter from ordinary rifle and machine gun fire.

For details regarding this latest scientific invention for the detection of submarines, etc., the following considerations will help to make clear the *modus operandi* of the apparatus in general:

At the top of the tube, the latter being represented by the figure 10 in the diagram, is a powerful electric searchlight 11, of any approved kind, which throws its rays through lenses 12 and 13, arranged to hold the rays in parallel relation. These rays are directed against a mirror 14, which is arranged at an angle at the lower end of the tube, and refracts the rays through the lens at the outlet of the tube. This latter lens can be shaped to throw the rays in parallel relation or to give any amount of divergence desired.

The tube, with the searchlight, lenses and refracting mirror, is attached to the outside of the vessel. Inasmuch as the searchlight is to be used on deck, a light of the highest power can readily be used. The tube can be adjusted so that it may be raised or lowered to bring the light to any desired point. Likewise the mirror can be moved for the same purpose, but the details of this adjustment have not as yet been considered exhaustively, because they do not concern the general scope of the invention. If a light is projected on both sides of the bow, the field which it is possible to light is almost equivalent to the field of human vision.

When the submerged field is lighted, the next step is to observe it properly, and to

(*Continued on page* 450.)



Latest Scheme for Locating and Destroying Submarines, Mines, etc., by Means of a Powerful Under-Water Searchlight and Periscope Device. Developed by Prof. Herschel C. Parker and Edward G. Hatch, M. E., of New York.

By Wireless 'Phone from Arlington to Paris

THE spoken word uttered in Arlington, Va., has been heard in Paris, France, on three different occasions recently, and particularly on the evening of Oct. 20 last. On that memorable date the human voice was projected across the Atlantic for the first time in history, and "Hellos" and "Good-byes" spoken in Arlington were heard and understood in the French capital, 3,800 miles from the point of transmission.

Announcement of the epochal achievement was made officially by the American Telephone & Telegraph Co., following cabled confirmation of the success of the wireless telephone experiments received in New York and in Washington from the company's engineers in Paris.

H. E. Shreeve and A. M. Curtis, of the staff of John J. Carty, the chief engineer of the American Telephone & Telegraph Co., went to France to represent the company in the transatlantic experiments.

Owing to the fact that France is at war and that wireless is playing a most important part in the working out of the French military communication system, it was with extreme difficulty that officials were persuaded to permit the use of the 1,000-foot Eiffel Tower station at Paris for the receipt of the radiophone messages from Arlington.

Only a few seconds at a time, in periods far apart, were allowed the American engineers, during which they were permitted to listen for the greeting from far away Arlington. In order that there could be no doubt of the genuineness of the tests, officers of the French Government, two or more of whom represented the army, were with Messrs. Shreeve and Curtis in Paris, while Colonel Samuel Reber, of the United States Army Radio Service; Captain W. H. G. Bullard, head of the United States Naval Radio Service, and other American army and navy officers watched intently the experiments at Arlington.

Mr. Carty, who not only heads the engineering staff of the telephone company but is president of the American Institute of Electrical Engineers, directed the experiments. Following the announcement of the success of the tests, he predicted that wireless telephonic communication between New York or any other American city and all the great cities of the world was but a matter of time.

The announcement given out at the offices of the American Telephone & Telegraph Co. follows:

"Transatlantic wireless telephony is an accomplished fact. Observers listening at the Eiffel Tower in Paris have heard speech sent out by engineers of the American Telephone & Telegraph Co. from apparatus developed by that company and the Western Electric Co. and installed at Arlington, Va. The equipment used was that employed a few weeks ago in talking 4,900 miles by wireless telephony to San Francisco and Honolulu."

That speech has actually been transmitted from Arlington to observers stationed at the Eiffel Tower, Paris, marks the conclusion of another chapter in the experiment undertaken by the American Telephone & Telegraph Co. When Mr. Carty's engineers commenced work on the long-distance wireless telephone experiments observers with receiving apparatus were sent not only to Panama, San Diego, Mare Island and Honolulu, but also two engineers, H. E. Shreeve and A. M. Curtis, were sent to Paris. Through the courtesy of the French Government, limited facilities for listening at the Eiffel Tower station were placed at their disposal.



Graphic Illustration of Arlington to Honolulu and Arlington-Paris Radiophone Tests Recently Conducted; the Distances Covered Being 4,900 and 3,800 Miles Respectively.

Full appreciation of the interest and extreme courtesy of the French Government can be understood when the great value of the Eiffel Tower station for military purposes is remembered. Due to the military necessities, the amount of time available for the wireless telephone experiments was so limited as to constitute a serious handicap to a speedy completion of the work. Added to this was the handicap resulting from the fact that all regular communication between Mr. Shreeve and the engineers in America had to be by cable and was subject to long delays.

Notwithstanding the difficulties of communication, the limited amount of time available for receiving, and despite heavy interference from high-power stations in the neighborhood and from static disturbances, speech was successfully transmitted on several occasions since.

In a cable message received by Mr. Carty concerning the results of the tests, Mr. Shreeve reported speech received by him and the time of its reception at Paris. The matter received at Paris was that sent from Arlington, where R. A. Heising, B. B. Webb and other telephone engineers were manipulating the apparatus at the transmitting station. Mr. Webb did the talking throughout the final experiments.

Simultaneously with the reception at Paris, speech sent out from Arlington was received on the wireless antenna at the Western Electric laboratories in New York and at the temporary station of the American Telephone & Telegraph Co. at the Pearl Harbor Navy Yard, Honolulu. Mr. Espenschied at Honolulu reported that he heard the conversation throughout the entire schedule and that Mr. Webb's voice was easily recognized.

After the announcement was issued Mr. Carty, who was in Chicago, was called up on the long distance telephone and asked to tell the story of the achievement.

"Tell us all about the Paris achievement," said an officer of the company in New York.

"Is anybody 'listening in?'" Mr. Carty asked, quickly guessing that newspapermen also were at the New York end of the line.

Mr. Carty laughed when told he had guessed rightly, and after a little persuasion told the story of the test.

"It was on the night of Oct. 12 when the first signal from Arlington was caught by Shreeve, in Paris. Shreeve heard the 'Hello' of Webb at Arlington several times. Again, the following night, the words were heard, and on Oct. 20 the words were again heard, not only in Paris, but in Honolulu, by Lloyd Espenschied, who cabled to-day that he heard the 'Hello, Shreeve,' and the 'Good-bye, Shreeve,' uttered by Webb in Arlington so plainly that he was able to recognize the voice as that of Webb.

"The announcement of the success of the experiment was deferred through courtesy to the French Government, and it was not until Oct. 22 when further cable confirmation of the success that has attended our efforts made it possible for us to take the public into our confidence and tell what has taken place.

"While Webb was talking to Shreeve he repeated the 'Hello' and 'Good-bye' several times, and they were heard each time in

(*Continued on page* 448.)

Audion Bulbs as Producers of Pure Musical Tones

By Dr. Lee de Forest

NOW that the attention of the public has been drawn to the astonishing use of the incandescent vacuum lamp, not only as a receiver in transcontinental wireless telephony, but as a generator of power necessary to transmit the voice in the first place, it may be interesting to know that this incandescent lamp, or "audion," has another entirely different field of utility—that of producing sound or music. Music from light—that, in a word—is the latest magic of this lamp.

Tradition has it that on the plains of Egypt three thousand years ago the giant statue of the Memni emitted weirdly beautiful notes when struck by the first rays of the rising sun. To-day, after three thousand years, it is interesting to know that we have at last reached the point of transmitting light rays directly into sound waves; that which has hitherto been only for the pleasure of the eye can now be made a pleasure also to the ear.

In my laboratory there are a number of small spherical incandescent bulbs, from which I am able to obtain a succession of musical notes, clear and sweet, of surprising volume, the pitch and timber of which can be varied almost at will to imitate any musical tone of an orchestra. Here, then, in the laboratory we have for the first time the music of the lamps.

While working on my experiments in developing the audion as a wireless telephone detector and incidentally as an amplifier to be used on long distance telephone lines I made the discovery years ago that when the circuits of the audion were connected in a certain way a clear, musical note was heard in the telephone receiver, which was connected in one of these circuits. The quality of the note was very beautiful, and I found after a little experimenting that I could change this quality of timber into a great variety of sounds, imitating, for example, the flute, oboe, cornet, stringed instruments and other sounds which, while pleasing to the ear, were quite unlike those emitted from any musical instrument with which we are familiar. The pitch of the notes is very easily regulated by changing the capacity or the inductance in the circuits, which can be very readily effected by a sliding contact or simply by turning the knob of the condenser. In fact, the pitch of the notes can be changed by merely putting the finger on certain parts of the circuit or even by holding the hand close to parts of the circuit. In this way very weird and beautiful effects can be obtained with ease.

At the earlier stage of these investigations I found that the pitch of the note could also be varied by a simple arrangement, such as a graphite pencil mark on a piece of paper or slate, connected across between certain parts of the circuit, and that this afforded the most ready means of altering the pitch and quality of notes.

Acting on these discoveries and suggestions I found it was a comparatively simple matter to arrange a crude scale similar in function to that of an organ, with switches in place of the ordinary keys, so that by pressing certain keys I could cut out, or in, more or less inductance or capacity or resistance, thus changing the notes emitted from the telephone receiver at will.

In order to bring the volume of sound out large and full in the room it was necessary to connect a number of loud speaking horns connected with telephone receivers similar to those which you have sometimes heard in the central railroad stations as train announcers. With these horns distributed in different parts of my laboratory, or grouped together in one place, the sound can be made to emanate from all quarters of the room or from one corner, as I choose.

In producing pure musical tones with an ordinary audion detector bulb, or with the special large size audion oscillator bulbs, the arrangement is shown diagrammatically herewith. At A there are placed in circuit two inductances, inductance No. 1 being of adjustable value, while inductance No. 2 has an iron wire core within it and also has taps taken out at equidistant numbers of turns to E connected to a series of switches or keys (and it is well to use, say, eight keys corresponding to a musical oc-



The Audion Piano May Entertain Us in the Near Future With Music Purer Than That Obtainable With Any Instrument Now Available. Also it Will Imitate Faithfully Any Orchestral Piece.

tave, thus giving eight notes). Of course, to produce more tones it is necessary to use more inductance taps, or condenser No. 3 may be of the adjustable type, so as to produce a variation in the musical tones developed in the circuit.

Using an ordinary audion detector bulb, the high voltage battery No. 4 may give 45 to 50 volts, composed of the ordinary 3-cell flashlight batteries. Where the large size oscillation generator bulb is employed 110 volts D. C. is adaptable to this part of the circuit. A D. P. D. T. throw-over switch may be used, as shown in the diagram, to throw the tone-producing audion on to a pair of ordinary radio receivers or on to a loud-talking receiver. The experimenter who wishes to try out this arrangement should try making different adjustments in the circuit, including the filament current applied, until the best results are obtained.

Several years ago, as the public of New York remembers, a very elaborate undertaking was started for producing music by gigantic electric dynamos mixing the tones from 100 or more machines in accordance with the wishes of the skilled performer who in that way produced musical tones of large volume, and which similated almost those of every instrument in an orchestra. This instrument was termed the telharmonium. The idea was to generate this music at a central station, where highly trained organists were constantly at the keyboard, and distribute it through telephone wires throughout the city to hotels, restaurants, lobbies, concert halls and private residences. This was a most meritorious idea and deserved great success. However, the extraordinary heavy cost of the original plant, the maintenance of the wire cables, etc., rendered it commercially a failure.

Now, with the audion or incandescent lamp as a generator of musical tones, we have on a small scale all of the possibilities of the large telharmonium.

Now, this same little bulb which I have just described, in addition to being a receiver of wireless messages and an amplifier for long distance wire telephones (in which use it is now employed on the transcontinental lines of the American Telephone & Telegraph Company), can be made to actually generate alternating current. It receives the energy which is expended in these currents from the dry battery or dynamo. The audion is, in other words, a transformer of energy. The alternating current, if of low frequency, can actuate the telephone diaphragm and make musical notes which the ear can hear, and this is the germ idea involved in the musical instrument which I have just described. The bulbs for musical purposes which I have thus far used are not larger than three inches in diameter.

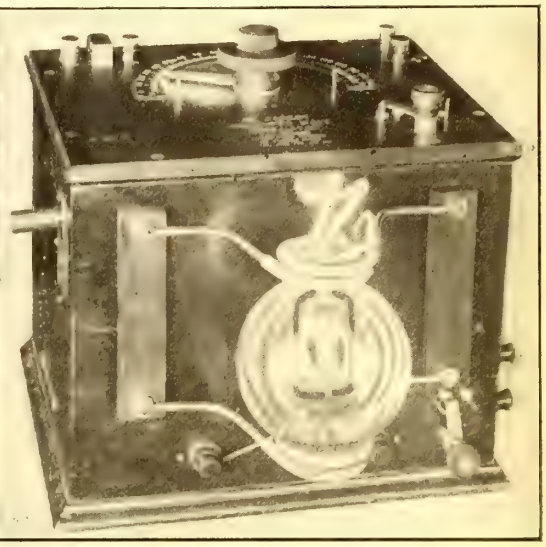
At the present time I am using one bulb for an octave on the musical scale, with the arrangement of keys and switches such that from this one bulb I can produce the notes of that octave by pressing the appropriate keys. For the next octave another bulb is used, and so on. The output of all these bulbs is made common to one set of telephone receivers or loud speakers, so that the total energy in the form of sound is that of all the bulbs which are operating at any one time.

In the same way when used as a wireless transmitter or generator the high frequency alternating current from the various bulbs is combined on the same transmitting aerial wire or antenna. Thus, if one oscillator is "developing" one-half horsepower 300 of these bulbs connected in parallel and acting on the same antenna will develop 150 horsepower. This is exactly the method which is used at Arlington by the Western Electric Company in generating sufficient energy to send the voice via radio to Honolulu.

In all my work with the audion—and I can imagine no device in the whole realm of practical physics of greater fascination than this little audion principle—I have never found any phase of its unlimited possibilities quite so interesting as this of producing musical notes. Although not a musician myself, I have always been exceedingly fond of music. The idea of producing beautiful musical tones by an entirely new method unknown to all our great composers and perhaps offering to future composers new fields for their genius, has truly captivated me. In the next twelve months I hope to be able to produce an instrument which will be far enough perfected so that I can turn it over to musicians to work out the thousand and one details of musical perfection which such men alone are capable of introducing.

The illustration here presented as worked out by the editor of this journal shows the probable appearance of an "Audion piano" of the not far distant future, utilizing the de Forest musical tube principle, by which means it is possible to produce the purest tones of any value ever obtained by any existing means. The various controlling handles are observed on the front of the piano, and the music is emitted from the large horns on top of same. A storage battery of small size will supply sufficient current for this wonderful instrument, and the feet might be utilized in assisting to effect variations in the audion bulb circuits. Each bulb is capable of producing an octave or eight notes. The large keyboard similar to those used on organs is well suited to this instrument, with which it will become possible to reproduce imitations of any band, orchestral or stringed instrument, etc. Extra oscillator bulbs for emergencies for use in case one should break, are seen lying on the stand at the left. It should be thoroughly understood that music produced by such an instrument as this is much purer in every way than that produced by any other type of musical instrument now known to the art and, moreover, the music is electrically produced in contradistinction to that produced by the usual musical pieces which yield sounds mechanically, so to speak.





Above: Dr. de Forest's Laboratory Where the Musical Audion Bulb Was Developed. The Large Tubes are Cooled by a Fan as Perceived. Note Elaborate Tuning Variable Condensers in Foreground.

At Right: Close View of de Forest Audion Oscillator Bulb, with Tuning Condenser in Case. Some of These Tubes Measure Seven Inches in Diameter. They Actually Generate High Frequency Oscillations.

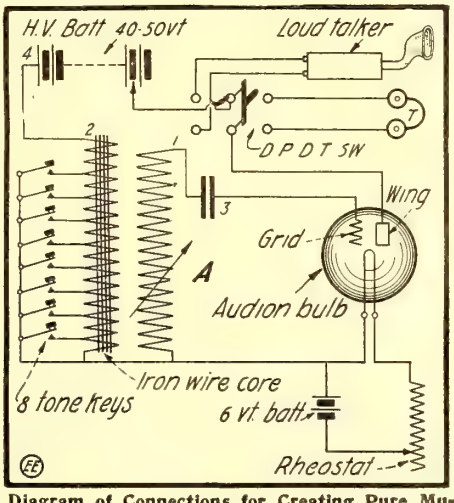


Diagram of Connections for Creating Pure Musical Tones with Any Audion Bulb.

PENETRATIVE POWER OF COLORED LIGHTS.

It may interest those engaged in sign lighting and signaling to know that lights of different colors show varying degrees of ability to penetrate the atmosphere. Some calculations, based on experiments, give the following results for the minimum intensity visible in a clear atmosphere at a range of two miles. (In these calculations light sources of equal area are assumed.):

Red	2.37	candle power
Green	1.96	" "
White	1.71	" "

The range of visibility of any light source depends, of course, upon the intensity of the source. However, it must not be supposed that by doubling the intensity the range will be doubled. The relation between the range and intensity varies for different colors.

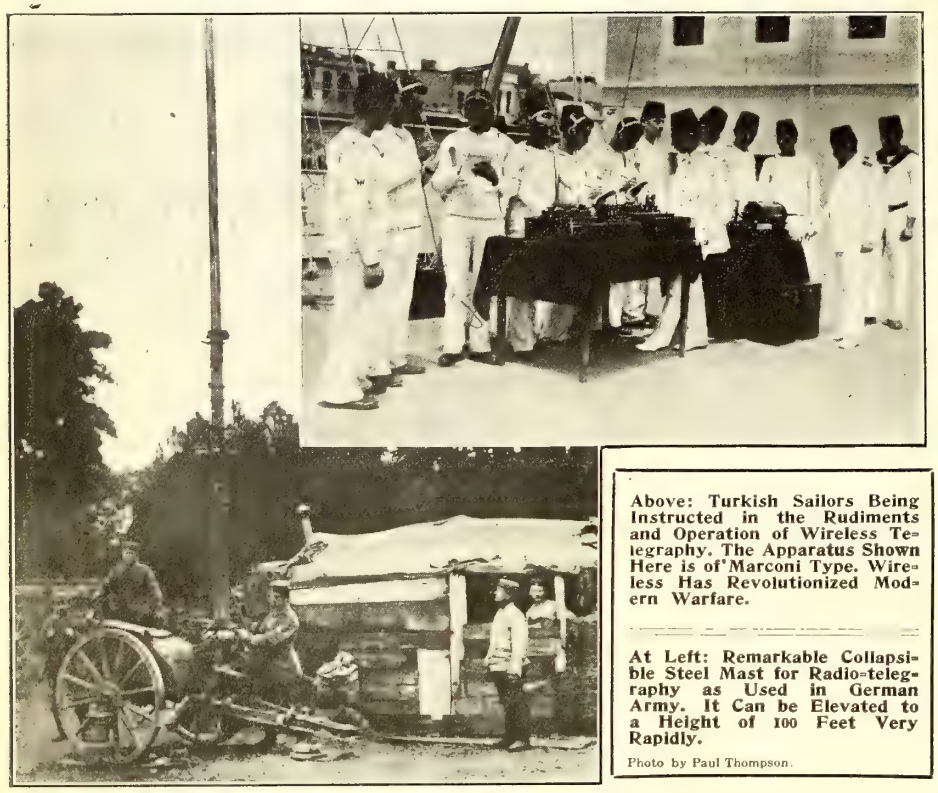
The great absorption of light in an atmosphere laden with water vapor is a well-known fact. A few years ago the German Government found that arc lights of 1,000,000 C. P., which were installed in a lighthouse, had less ability to penetrate a fog than a 10,000 candle power oil lamp. This indicates that electric incandescent lamps having more red rays would be superior to arc lamps for use in light-houses.

Dust and smoke unquestionably interfere more with the transmission of blue or green light than with red light. Therefore, when viewed through the atmosphere, all lights should appear redder. On weighing the evidence, it seems that reddish illuminants should have more penetrative power that bluish lights, and where details are to be distinguished at a distance the red light is more readily focused than by any other color. Hence the use of red danger signals on ships and railroads.

Wireless Telegraphy Aids the Teutonic Allies

The photographs presented herewith illustrate some of the up-to-date wireless telegraph equipment in use by the German army and also by the Turks. The smaller photograph shows a complete Marconi radio set as used in teaching the Turkish sailors the rudiments of the art. The outfit as perceived includes a multiple valve tuner of the latest Marconi style, as well as a magnetic detector. The transmitter comprises a 10-inch spark coil, together with storage batteries and other auxiliary apparatus. Regular wireless messages are being received by the students here shown. The Turks have made good use of wireless telegraphy in their numerous brilliant maneuvers on land and sea.

The larger illustration shows a telescopic steel radio mast which can be elevated to a height of 100 feet very rapidly, and the machinery for performing this work is mounted on the truck here depicted. Suitable guy wires are provided for strengthening the mast as it is projected upward, and the total work of raising same to its maximum height, ready for the purpose of transmitting and receiving messages over a fairly large range, can be accomplished in a few minutes by the well trained German radio corps. The wireless apparatus is contained in another cart not shown in the picture. The whole equipment forms a very compact and easily portable outfit.



Above: Turkish Sailors Being Instructed in the Rudiments and Operation of Wireless Telegraphy. The Apparatus Shown Here is of Marconi Type. Wireless Has Revolutionized Modern Warfare.

At Left: Remarkable Collapsible Steel Mast for Radio-telegraphy as Used in German Army. It Can be Elevated to a Height of 100 Feet Very Rapidly.

Photo by Paul Thompson.

VINELAND HIGH SCHOOL RADIO ASSOCIATION.

The Vineland High School Radio Association, of Vineland, N. J., was recently organized. Leslie H. Adams was elected president; Firman A. DeMaris, vice-president; Franklin Lamb, secretary, and Frank M. Comfort, treasurer and advisory president.

The association has secured permanent rooms, through the kindness of the Board of Education, in the physical laboratory of the new Vocational High School.

The aerial will have an average height of 100 feet and a length of 250 feet. The set will consist of a ½-k.w. transmitting set and a receiving set of standard make.

The object of the association is to bring the amateurs of Vineland and vicinity in closer relation and to purchase elaborate equipment which would be impossible otherwise.

The association would like to get into communication with other clubs. All correspondence should be sent to Franklin Lamb, 623 Elmer street, Vineland, N. J.

THE MOST LONESOME RADIO STATION.

On Swan Island, in the Caribbean Sea, is situated what is probably the most isolated wireless station in the world. The station crew is made up of three operators, two engineers, a cook, a machinist and three laborers. No women are permitted to land on the island. Men who express a willingness to go to Swan Island are obliged to sign a contract whereby they agree to remain at least 18 months or waive their right to free return transportation. Those remaining the full period of service are returned to their homes by way of one of the Central American ports and are granted six weeks' vacation with full pay.

Strangely enough, there is no difficulty in obtaining men to man the station. Applicants, indeed, exceed the number of vacancies. Board and lodging, of course, are supplied, a boat bearing all provisions necessary, including fresh meat, and the mail as well, arriving regularly every two weeks. Some men have remained on the island as long as two years and a half and, subsequently, have been glad to return to the station.

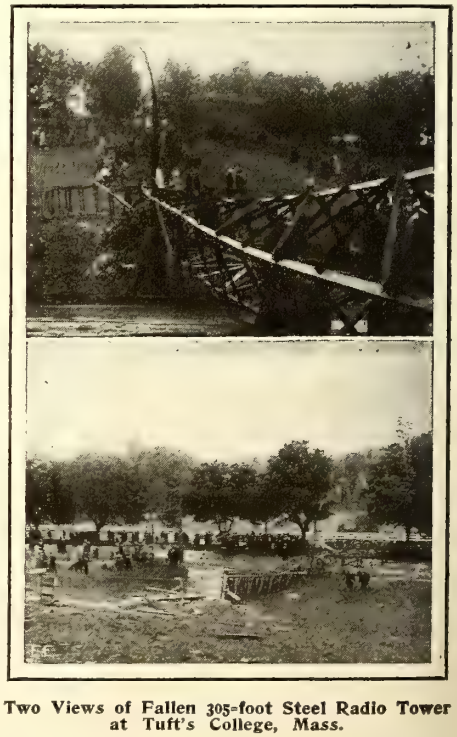
305 FOOT RADIO MAST BLOWN DOWN.

On September 26 last the 305-foot steel wireless tower of the American Radio and Research Corporation was blown down at Tufts College, Mass. Through carelessness in erection details the tower fell, it is claimed. The accident was the result of insufficient temporary guying. It had been erected to its full height, but was not entirely completed. It was made up of structural steel with a cross-section of 3 feet 4 inches square, and followed the same dimensions all the way up; the total height was 305 feet. The plans called for three sets of guy ropes at intervals of 100 feet of height. The two lower sets of guys were permanently in place, but some 5-16-inch steel rope was fastened temporarily to the top. As the design called for ¾-inch crucible steel guys for the top, it is evident that the guys used temporarily had an ultimate strength of only 1-12th that called for by the plans. The high wind of September 26 last parted the temporary 5-16-inch steel rope, allowing the top of the tower to sway out, thus bringing into play enormously high stresses at the next lower set of guys. This undue strain snapped first the middle set of guys and then the lower ones.

Some interesting features were noted in the falling of this tower. There were no signs of buckling, the tower falling as a unit indicating great rigidity. It fell across a street railway line, cutting down the trolley wires and feeder cables across the tracks of the Boston & Maine Railway, derailing a locomotive. When the locomotive fender caught the end of the mast it dragged the tower 50 feet down the tracks, twisting the steel somewhat. It was remarkable, however, the way the steel held together, shearing off the bolts rather than pulling out the bolt holes.

The tower was insulated from the ground. Some of the base insulators remained intact, although a few were crushed, due to the side thrust of the falling mast.

The rebuilding of the tower was started immediately. After the new insulators were in place and the cement hardened the steel work was started anew. It is now up 60 feet and should be completed within a short time. All the anchor blocks were perfect, showing no trace of the strain exerted when the tower fell.



Two Views of Fallen 305-foot Steel Radio Tower at Tuft's College, Mass.

Never dust electric globes while unlighted. The static electricity generated will break the filaments.

POWERFUL SEARCHLIGHTS WORK WONDERS IN MODERN WARFARE.

In modern warfare some of the greatest battles are not fought in the daytime, but at night, when darkness provides a mighty impenetrable blanket over land and sea. For that reason the enormous armies now engaged in the titanic struggle in Europe invoke the use of powerful electric searchlights which blaze forth over the battleground at night, so that advances and sorties may be made regardless of nature's handicap. Our illustrations show a clever method for handling, to the best advantage, a powerful electric searchlight projector and, moreover, its mounting is cleverly placed on a specially constructed wagon, as perceived. This vehicle carries at the rear two large reels of flexible cable, which serve to supply the arc lamp with current from a petrol engine and dynamo plant similarly mounted on a wagon, but located in most cases at some distance from the projector.

When the searchlight wagon has reached the point where it is to be used on the field the telescopic, collapsible framework here shown is elevated in a few seconds to any desired height and the searchlight can now be swung to whatever direction desired. A flexible electric cable leads down from the projector case to make connection with the wires leading back to the dynamo truck, as aforementioned.

This outfit is also equipped with a military type telephone instrument, whose circuit runs back to the rear army guard. Note how the truck is partially covered with pine boughs in an effort to conceal the outfit as much as possible from the reconnoitering aeroplanes of the enemy during daytime. Some of these schemes are carried out in such detail that the apparatus cannot be observed at all, even when the scouting aeroplane flies but a short distance above the earth. The particular searchlight here shown has done effective duty in Northern France, and, as may be judged from the pictures, this unit forms a part of the wonderful German signal corps equipment, which is said on good authority, to be second to none in the world to-day. It must be remembered that in most instances, not one or two searchlights are used on the battlefield, but whole batteries of them are brought into play simultaneously, so that the ground is brilliantly illuminated for several miles, thus for all practical purposes they take the place of the sun itself. Occasionally one of these powerful searchlight beams spots an enemy's aeroplane at night, and in several instances it has resulted in the flying scout being brought to earth in short order by the effective use of anti-aircraft guns.

The majority of these devices operate on 80 to 110 volts, direct current, and consume from 5 to 15 kilowatts. Some searchlights require less, where they are used for minor work, and likewise some of them take more energy than above mentioned. The American Army and Navy are equipped with some of the largest projectors extant, several of which measure 60 inches and more in diameter across the reflector. The front opening of the lamp cases are closed with glass, but this is not in one piece. It is divided up into several narrow strips to permit greater facility in replacement, and also to more efficiently take care of the unequal expansion and contraction of the glass, due to the enormous amount of heat developed by the arc, and which is moreover reflected against the glass by the parabolic mirror in the rear of the lamp housing.



Above: German Signal Corps About to Put Into Operation One of Their Powerful 36-inch Electric Searchlight Projectors for Night Fighting. Left: Supporting Frame Elevated. Note Screen of Trees to Help Disguise It From Enemy During Day.

Photos Copyright by Underwood & Underwood.

HOW THE WIRELESS "WIZ" CELEBRATED XMAS.

(*Continued from page* 390.)

"Well, see you later in the day," I sang out. * * *

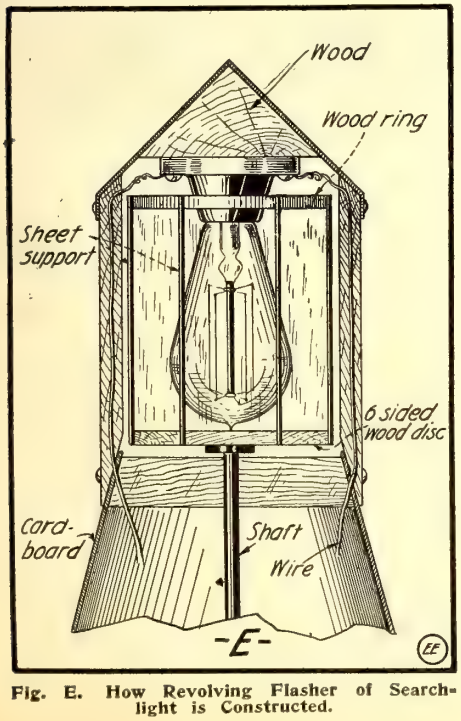


Fig. E. How Revolving Flasher of Searchlight is Constructed.

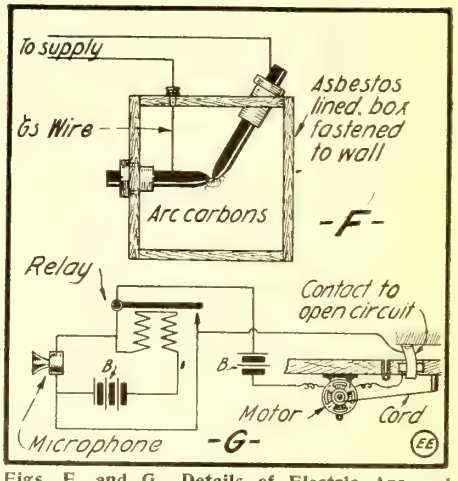
"Are you ready for the dope now?" inquired the "Wiz" that night at 11, as he sank into the chair at his desk and drew forth a few sheets of blank paper, on which he proceeded to make some sketches. "Well, I'll now 'wise you up' on the railroad stunt first. I was certainly stuck for a while on the switches for this system, till I got into communication with a New York electrical firm and managed to get hold of a complete list of miniature railroad supplies to fill my bill. I used two stations—'A' and 'B' (see sketch A)—and one siding made of standard track.

"The three switches were electrically operated from the switchboard and were made similar to this sketch B. Two magnets were mounted with a pivoted magnetized arm to play between them. This pivoted arm was fastened to the bar that swung the switch, and by throwing the current in one direction or the other I was able to open or close the switch.

"The third rail on the side-track and stations was disconnected from the main system, and I had switches 1, 2 and 3 arranged to control them, while switch 4 controlled the current to the main track. The electric switches 5, 6, 7, 8, 9 and 10 controlled the operation of the track switches. I also rigged up magnetically controlled reversing stops at several points, marked X, controlled by keys 11, 12, 13, 14, 15 and 16. These reversers also operate the semaphores by means of the sliding rod, 'R,' pushing the arm into 'Danger' position.

"Now the operation of the system can be briefly outlined as follows: Making the freight train's station, 'A,' and the express train's station, 'B'; then, by closing the switch 1, the freight train is started out on the main track and runs in the direction indicated by the arrow. When it has just passed the express station we may throw the current into that track by closing the switch 2, and the express train will start out in the opposite direction. It will look just like a head-on collision, but by depressing the key 9 the switch is opened that allows the freight train to run onto the side-track; and the button 14, controlling the reverse, is pressed at the same time and the reverse gear will cause it to

(*Continued on page* 451.)



Figs. F. and G. Details of Electric Arc and Microphone Control Relay Used to Open Door.

The United States Advisory Board and Its Personnel

THE newly-appointed United States Naval Advisory Board of scientists, inventors and engineers, which is the outcome of an excellent idea originated by the Secretary of our Navy, Josephus Daniels, recently held its first meeting and several important matters were taken up at that session. A consulting staff of specialists, such as here brought together, should have been available for the benefit of our Government many years ago, and it is really remarkable that such an idea was not formulated and carried through long before now.

The photograph herewith shows the members of the Advisory Board at their first meeting in Washington, D. C., and below is given a brief outline of the qualifications of the savants and engineers who make up this staff, which is headed by Thomas Alva Edison as Chairman of the Board.

Mr. Edison is probably one of the most widely read and experienced scientific men available in this country to-day, and so we may indeed congratulate ourselves in having such an able electrician and inventor at the head of this illustrious body of well-trained specialists which, in its entirety, covers practically all branches of applied science with which we are familiar to-day—from navigation to wireless.

Thomas Alva Edison was born in 1847 in Milan, O. His early education was entirely self-acquired, and he very early took up the vocation of a railroad telegraph operator. However, his leaning toward scientific and technical matters caused him to invent at an early age an attachment for telegraphic apparatus. He finally disposed of one of his inventions at a goodly sum, which really started him on the road to his present wonderful success as a captain of industry and invention. It would be hard indeed to find a man with a more general and widely extended education than Mr. Edison and, as we know, he has been responsible for many of our greatest mechanical and electrical devices of untold benefit to the human race, such as the electric light, phonograph, motion picture machine and storage batteries, etc. In all, this phenomenal man has taken out over 1,200 patents on various inventions.

Two well-known mathematicians were nominated to the Board by the American Mathematical Society. These were Professor Robert Simpson Woodward, of Washington, D. C. and Professor Arthur Gordon Webster, of Worcester, Mass. The former gentleman is a well-known engineer and an expert in astronomical matters. He was born in Rochester, Mich., in 1849 and graduated with the degrees of Civil Engineer and Doctor of Philosophy. He has also received honorary degrees from the Universities of Wisconsin, Columbia and Pennsylvania. Part of his experiences covered positions as assistant engineer in the United States Lake Survey, assistant astronomer in the United States Transit of Venus Commission, etc. He was at one time Professor of Mechanics, Physics and Mathematics at Columbia University and also served in the capacity of president of Carnegie Institution and has besides served in various capacities in numerous scientific societies. Professor Webster is Professor of Physics at Clark University, Worcester. He was born at Brookline, Mass., in 1863 and graduated from Harvard University. He has spent much time abroad at scientific schools in Berlin, Paris and Stockholm, and is considered an authority on physics.

The two members nominated by the American Society of Civil Engineers were Alfred Craven and Andrew Murray Hunt. The former gentleman has been for many years connected with the various branches of the municipal engineering department of New York City. He is a son of Rear Admiral Thomas C. Craven and a nephew of Alfred W. Craven, for many years Chief Engineer of the old Croton Aqueduct. He was born in Bound Brook, N. J., in 1846 and graduated from the United States Naval Academy. In 1910 he became Chief Engineer of the Rapid Transit Commission of New York. His experiences have been varied and most thorough, and his opinion on engineering and technical matters is taken as final. Mr. Hunt comes from San Francisco and occupies a prominent position as an engineer in that city. He also graduated from the United States Naval Academy in 1879. He is a specialist in steam and gas engine plant design, as well as hydro-electric developments of large extent.

The Inventors' Guild selected two members for the Board, namely, Peter Cooper Hewitt, of New York, and Thomas Robins. Mr. Hewitt is a New Yorker born and bred, and first saw the light of day in 1861. He graduated from Stevens Institute with the degrees of mechanical and electrical engineer. He was also honored with a degree of Doctor of Science from Columbia University. He has performed very extensive research work in the direction of mercury vapor and mercury arc devices, such as rectifiers, illuminating devices, etc., and latterly has taken up the work of developing special generating and amplifying mercury vapor apparatus for use in radio-teleg-



Photo Copyright by International Film Service.

In the above illustration looking from left to right, the following members of the new Naval Advisory Board appear as indicated: 1. Josephus Daniels, Secretary of the Navy; 2. Thomas A. Edison, Chairman of the Board; 3. Elmer Ambrose Sperry; 4. Arthur Gordon Webster; 5. Hudson Maxim; 6. Lawrence Saunders; 7. Benjamin G. Lamme; 8. Frank Julian Sprague; 9. Henry Alexander Wise Wood; 10. Lawrence Addicks; 11. Howard E. Coffin; 12. Spencer Miller; 13. Thomas Robins; 14. Wm. L. Emmett; 15. L. H. Baekeland; 16. Benj. B. Thayer; 17. W. R. Whitney; 18. Peter Cooper Hewitt; 19. Joseph W. Richards; 20. Alfred Craven; 21. Andrew Murray Hunt; 22. Andrew L. Riker; 23. Robert Simpson Woodward; 24. Matthew B. Sellers.

ETHEREAL ELASTICITY.

The Danish physicist Oersted, in 1819, discovered the magnetic effect of electric currents upon needles. It created a great deal of excitement at the time because it was the first clew which had been found that a relationship existed between electricity and magnetism. The idea that a third electricity existed was never advanced until my "Electrical Theory of the Universe" was published, says Prof. G W. Cooper, suggesting that an electron of electricity was composed of positive, negative and magnetic electricity, magnetic occupying the center of an oblong electron. The ether of space has been referred to by many scientists as the elasticity that holds our earth to the sun, or bodies of the universe in their respective places, but no scientist has ever attempted to explain what that elasticity is. If we accept the theory of three kinds of electricity and allow each electron in nature to set universally north and south, unless otherwise deflected, and that like electrically repels and unlike attracts (meaning positive and negative electricity); also that magnetic electricity attracts positive, negative and magnetic. The drawing will illustrate this arrangement of electrons, showing lines of attraction and repulsion. If we pull the electrons apart endwise and let go they will instantly fly back to place; if we pull them apart or push them together sidewise and let go they will return to their former position.

If we accept this theory we have the only explanation of the elasticity of the ether of space, and if the earth was pulled out a million miles farther into space and released, it would go back into position so gently that we would never know it happened. Now, if we change Newton's famous law of gravitation and use electrons instead of bodies, here is the result: Any two masses of electrons (meaning any magnets) in the universe attract each other

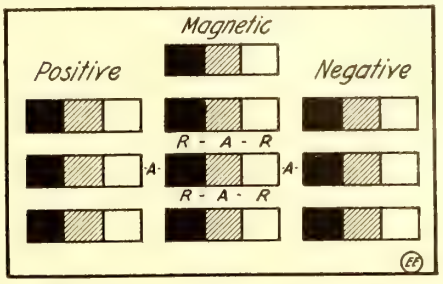


Diagram Showing Arrangement of Positive, Negative and Magnetic Electrons. Attraction at A; Repulsion at R.

with a force which is directly proportionate to the product of the masses and inversely proportional to the square of the distance between them; also, every electron in the universe attracts every other electron with a force which varies inversely as the square of the distance between the two electrons.

HUMANE USES OF WIRELESS 'PHONE.

Since the recent wonderful achievement of successful wireless telephony from the Atlantic coast to Honolulu suggestions are forthcoming of possible life-saving uses at sea for this latest scientific miracle. If the device had been perfected a few years earlier the Titanic disaster might have been averted, for President Vail, of the American Telephone & Telegraph Co., predicts the employment of the apparatus as a protection to liners against icebergs. The idea is to equip a lifeboat with a wireless telephone, and when a ship gets into a fog where ice may be met, to send the boat ahead as a scout to give warning of danger. This use would also guard against collisions between vessels in fog, which have cost so many thousands of lives in maritime history.

Again, when a man has fallen overboard, it often happens that rescuers sent out in a small boat cannot see him, although he may be plainly visible from the ship's crow's nest. It is pointed out that the lookout could direct the rescue if the lifeboat were fitted with a wireless telephone. Then, too, there would be the value of wireless telephony to castaways from shipwrecks. Communication between their boats and passing ships would be comparatively easy. The wireless "telephone" has an immense advantage over the wireless "telegraph" in that it does not call for the presence of a skilled operator, and the mechanism is much simpler. Thus the newest marvel of modern science bids fair to rob sea travel of much of its danger and suffering.

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raphy and telephony. Thomas Robins is a resident of Stamford, Conn. He was born at West Point, N. Y., in 1868 and graduated from Princeton University. He is in business in his home city, holding the position of president of the Robins Belt Conveyor Co. He also serves as secretary of the Inventors' Guild and is a member of a number of technical societies.

The American Society of Automobile Engineers is represented by Andrew L. Riker and Howard E. Coffin, both of Detroit. The former was born in New York City in 1868 and is a graduate of the Columbia Law School. He later became greatly interested in the problem of mechanical propulsion of vehicles. One of his early inventions was that of the first electrically propelled vehicle in this country. His experience with gasoline engines and vehicles adapted to propulsion by this means has been vast and varied. Probably one of the best-known men in the automobile line is Howard E. Coffin. He was born at West Milton, O., in 1873 and studied at the University of Michigan, where he received the degrees of B.S. and M.E. He was for several years in the United States Civil Service, along the line of internal combustion engineering and was for some time in charge of the Olds Motor Works' experimental department, at which plant he later served as chief engineer. Since 1910 he has held the office of vice-president and consulting engineer of the Hudson Motor Car Co.

From the flying world two well-known inventors were selected through the courtesy of the American Society of Aeronautic Engineers. These representatives are Henry A. Wise Wood and Elmer A. Sperry. Mr. Wood hails from New York. He has perfected and developed many appliances in the realm of printing machinery and for which he was awarded a gold medal by the Franklin Institute. Among his societies is the Society of Naval Architects and Marine Engineers. For some time he has been an enthusiastic student of, and a writer on, aeronautical subjects. He was born in New York City in 1865 and received his early education in the Media Academy at Media, Pa. The latter gentleman—Mr. Sperry—is well known to-day for his inventions pertaining to the automatic stabilizing of aeroplanes. He also is an electrical engineer of ability, besides having had wide experience in many other lines of engineering and industry. He was born at Cortland, N. Y., in 1860 and received his degree from Cornell University. He is a member of many scientific and technical societies and should prove indeed a very able and valuable member of the Naval Advisory Board.

From the American Society of Mechanical Engineers there were nominated William LeRoy Emmett, of Schenectady, and Spencer Miller, of South Orange, N. J. Mr. Emmett was born at Pelham, N. Y., in 1859 and graduated from the United States Naval Academy and has also received the honorary degree of Doctor of Science from Union College. He has specialized in electrical engineering. At present he is connected with the illuminating engineering department of the General Electric Co. Mr. Miller serves as chief engineer in the cableway department of the Lidgerwood Manufacturing Co. He was born in Waukegon, Ill., and graduated from Worcester Polytechnic with the degree of B.S. He has made a number of inventions relating to apparatus for saving life at sea and cableways for coaling vessels at sea, which devices are used by the Navy Department of the United States Government.

In electrical science two brilliant men were selected by the American Institute of Electrical Engineers; namely, Frank Julian Sprague, of New York City, and Benjamin G. Lamme, of Pittsburgh, Pa. As a pioneer in the development of electric railways and devices for the control and operation of same, Mr. Sprague is well known and he has served in many important capacities with various corporations. He was born in Milford, Conn., in 1857 and graduated from the United States Naval Academy. He was at one time assistant to Thomas A. Edison and has acted as consulting engineer to the Edison General Electric Co., the General Electric Co., and as a member of the Terminal Commission for the Electrification of the New York Central Railway. Mr. Lamme was born on a farm near Springfield, O., and graduated as a mechanical engineer from the Ohio State University. He has had a large amount of designing and other experience with the Westinghouse Electric Manufacturing Co. at Pittsburgh, and at present holds the position of chief engineer with that corporation. He is one of the best-known men to-day in the field of large size alternating current electrical machinery design, and the mighty generators at the Niagara Falls power plant are constructed after his designs. He holds many patents on electrical machinery. One of his particular pleasures is in discovering and assisting young men of ability along the lines of his chosen profession.

In the field of aeronautics two well-known men have been appointed by the Aeronautical Society of America in the persons of Hudson Maxim, of Brooklyn, N. Y., and Howard Bacon Sellers, of Baltimore, Md. The former is well known throughout the world for his original and important research work on high explosives and his activities have covered many other fields of sociology, philosophy and science. He was born in Orneville, Me., and at an early age he engaged in the publishing business. Later he took up the work of inventor and experimenter, developing the first smokeless powder ever used by the United States Government. This invention he later disposed of to the Du Pont de Nemours Powder Co., of which he became the consulting engineer and expert in research work. In later years he has evinced great interest in aeronautical science and has made many valuable suggestions along this direction. Mr. Sellers was born in Baltimore and there he received his early education. He studied in the Law School of Harvard University, from which he later graduated, and then followed up this work with courses in the Laurence Scientific School and the Drexel Institute in Philadelphia. He was the first editor of *Aeronautics* and is also a member and past chairman of the technical board of the Aero

(*Continued on page* 450.)

The Electrical Burglar of the 20th Century

IT is, indeed, surprising what ingenuitp and ability are shown among the criminal classes in quickly adapting the latest advances in the electrical and mechanical sciences to their art—if we may so call it—of breaking into safes, vaults and buildings. The up-to-date burglar has many marvelous scientific devices at his beck and call, and most of them require but little knowledge of science or the trades in order to operate them very effectively.



The Modern Burglar Utilizes Electricity to Find the Combination of a Safe and for Numerous Other Purposes.

Our illustration herewith depicts a 20th century burglar in the act of blindly checking up the combination lock on a steel safe by means of a very sensitive telephone outfit, known as a "Detectaphone." The microphone transmitter of this supersensitive telephone set is held, by means of a rubber suction cup, against the front of the safe door in proximity to the combination lock mechanism. When the knob carrying the numbered dial of such a lock is rotated, the movement of the bolts on the inside of the door can be heard, and in some cases the interlocking of the various parts of the lock mechanism proper can be perceived by this arrangement. It thus becomes an easy matter for a clever safebreaker, with a little patience, to readily open any ordinary safe or vault door fitted with this type of lock, without knowing the actual combination numbers by which it was locked in the first place. The telephone set is completed by a pair of sensitive telephone receivers placed over the ears as our illustration indicates, and the battery for this set may be carried in the pocket as depicted at B.

A second detectaphone set is often utilized by a confederate, for the purpose of indicating the approach of the police, etc., on the outside of the building. The accomplice is stationed at the door in the illustration thus pictured, in the act of detecting the approach of any persons outside of the building or also within same. In this case the supersensitive microphone transmitter of the detectaphone is placed outside the front door of the building or down the length of the hall, as the case may necessitate.

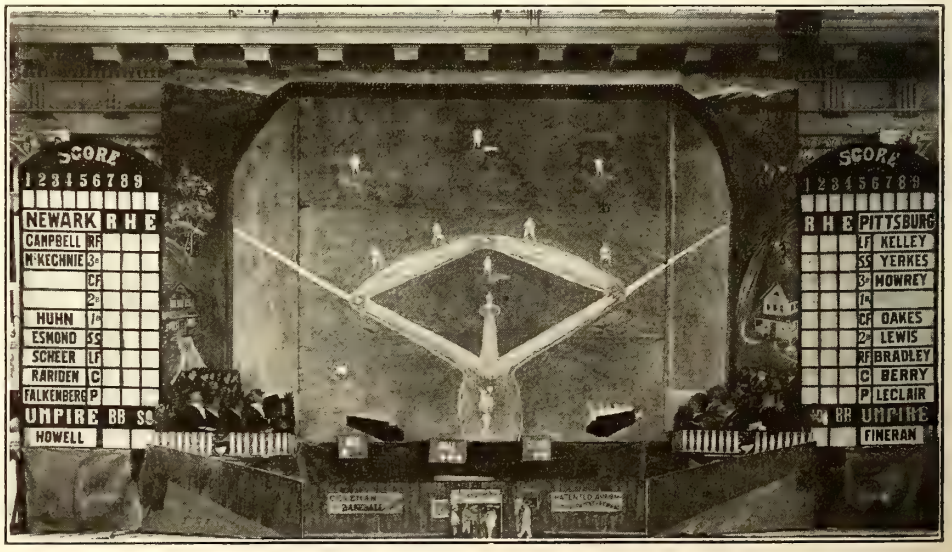
While on the subject it may be of interest to state that the yeggmen and second-story "artists" of our day use nothing but electric flashlights or battery lamps, and one is here shown illuminating the combination lock dial of the safe.

A cable is perceived dropping down from a convenient electrolier and terminating in a large disc fitted with a carbon electrode and insulated handle, which lies in front of the burglar who is attempting to open the safe. A pair of smoked goggles are necessary in conjunction with the use of this electric *arc burning* apparatus. Whenever the safe lock refuses to yield to the treatment aforementioned, it is a matter of but a few moments, relatively speaking, to ground one side of the electric circuit to the safe and by means of the shielded electrode just mentioned, an arc is readily established between it and the surface of the safe door. This "arc" is one of the hottest fusing agencies known to modern science. It has a temperature of from 6,000 to 7,000 degrees Fahrenheit, and it is needless to say that the hardest nickel steel, even though Harveyized or chilled, will soon be melted by the intense heat of the incandescent electric arc gaseous stream thus produced. As may be readily imagined, it would take but a short time to literally "bite" the lock mechanism right out of the safe door. When this work has been performed it is a simple matter to throw the bolts and open the door in most cases.

However, in this instance as well as in most others, and in accordance with the old proverb, "There never was a smart man but that there was a smarter one," it is safe to say that sooner or later the most clever and cunning tricks of the best yeggmen are ferreted out or compensated for by equally clever counteracting ideas as promulgated and devised by our modern detective and police experts. The selenium cell is probably one of the best devices with which to foil the would-be safebreaker, for the minute he flashes a light on the spot where the selenium cell is concealed, an electric bell will ring in any part of the building desired or at police headquarters, notifying the proper parties instantly as to where the alarm originated. Thus it is that the march of science is constantly toward a higher plane, endeavoring to eliminate any weak spots in diversified applications to the needs of society and the fine arts.

SEEING A BASEBALL GAME BY WIRE.

One of the most novel and entertaining inventions of the 20th century is that enabling one to *see a baseball game by wire.* This is illustrated in the accompanying photograph which depicts an exact reproduction of a baseball field, but on a miniature scale. The action of the complete device is very human; that is to say, each performance of the player is so naturally



This Electrically Operated Baseball Diamond in Miniature Duplicates Every "Play" Made.

(*Continued on page* 454.)

ELECTRICAL PROSPERITY WEEK.

By John A. Randolph.

(The Society for Electrical Development.)

OPTIMISM, enduring, persevering, finally triumphant, made the biblical legend of "Job" a classic. Job looked on the sunny side, kept plugging, and achieved prosperity in the end. The moral is obvious.

With the same faith in destiny, hope for the future and confidence in truth, the united electrical interests of the country have planned a big sales campaign for the week of Nov. 29 to Dec. 4.

They have called it ELECTRICAL PROSPERITY WEEK, a fitting name, fraught with wholesomeness and characterized by the spirit electrical.

It is to be an event, a six-day celebration, in which the people throughout the United States from the Canadian frontier to the borders of Mexico, from ocean to ocean, will be shown the wonders of electricity as never before—will be taught how inseparably linked with modern progress this all pervading force has come to be. In short, the purpose is to advocate, demonstrate, promulgate, electricity.

The Goddess Electra.—The emblem of the celebration is a design beautifully symbolical of the broadness in scope, the cleanliness, convenience, economy of electricity. The central figure is the "Goddess Electra" in the act of closing an electric switch. A look of confidence and satisfaction illumines her countenance, as our illustration portrays. Electricity is her servant. The attractive background shows a residence section on one side and a city street on the other, with electric light and power everywhere. The home scene is peaceful. It suggests things as they ought to be—where drudgery has passed, to give way to cleanliness and purity, the light of truth.

The city street is suggestive, at once, of efficiency, system, speed—tasks done automatically, everything moving at the push of a button.

The design was as carefully chosen as the other features of the campaign. It was selected only after weeks of careful consideration, during which a large number of other designs produced by many of the foremost artists of the country, were submitted for approval.



Official Design for Electrical Prosperity Week.

The story of the choosing of the model for the "goddess" was published in the newspapers throughout the country. She was chosen by contest, the final selection being made by a jury of well-known artists. The winner was Miss Florence Cassasa, of Brooklyn.

The spirit of the celebration will be education. The public will be shown as never before that electricity is a necessity, not a luxury; is economical, not expensive; is simple, not complex; is broad in scope, not limited; is safe, not dangerous; is, in short, the most willing, reliable, able servant mankind has ever known.

Displays, exhibitions, lectures, parades, shows will be held everywhere—presenting, demonstrating, explaining things electrical as never before. A blaze of illumination from coast to coast will come at night as a climax to the activities of the day. Myriads of electric lamps of all types, shapes and sizes will take up the light where the sun leaves off. The coolness of the year will make people actively receptive. Meetings in full sway everywhere will offer unbounded facilities for lectures.

The schools will be in session, and will provide a means of setting forth the advantages of electricity to the coming generations by prize essay contests upon electrical subjects, "Electurettes," recitations, readings, addresses embodying the electrical spirit.

UP-TO-DATE SHOPPING BY TELEPHONE.

Newark, N. J., has a new shopping idea. Usually there are two ways of shopping—either by telephone or going personally into the store. This shopper goes to the window of the store, which in this case is the Western Electric Co.'s supply depot at 64 Park place, picks up one of the several Inter-phones extending through to the street side of the window, and talks to the clerk inside, as perceived from the photo.



Electrical Supply Store Uses Telephone Outside of Show Window to Attract Customers.

Experts in selling goods to the public often say that if a dealer can only get people inside his store he will sell goods. That's why so many bargain days are conducted. People come for the bargains, but also buy other goods. Just to try out the psychology of this claim the local manager of this store decided to find a way to sell goods and take orders without his customers coming inside at all. An increase in sales has resulted.

Here's the way the new electrical seller is worked out: A desk equipped with order books, Inter-phones and electrical devices has been placed just inside the show window. One of the office force sits at the desk in plain view of the passing thousands. He is a very busy young man. His desk 'phones are connected up to lines which reach to the outside. A customer comes along, sees some electrical appliance that he needs, picks up the outside Inter-phone, speaks quickly to the clerk in the window, who is there to take down orders, and asks the clerk for further details about cost, etc., of devices in the window. Usually a crowd stands about waiting for a chance to ask questions. Addresses are obtained and the mailing list improved by the arrangement, besides giving to the public an excellent idea of how an up-to-date concern handles its office work.

ELECTRIC SHOWER FOR A BRIDE TO BE.

It is the custom among young people to give a "shower" to a bride to be and bestow upon her gifts that she is likely to need in her future home. There are linen showers and handkerchief showers, tinware and woodenware showers, but the very latest is the "electric" shower!

Miss Irene Brothers, of Nela Park, Cleveland, was the fortunate recipient of such a shower recently when her engagement was announced. The event took place in a beautiful ravine in Nela Park. Electric Japanese lanterns were strung among the trees. An electrically cooked supper was served. Among the electrical devices presented to Miss Brothers were an electric coffee percolator, toaster, grill, electric iron, hair drier, tea urn and table lamp, all of which can be utilized to best advantage in the modern home.

Man to man—can you afford to miss a single issue of this magazine?

SUBWAY IMPROVEMENTS CAUSE GREAT CHANGE IN ELECTRIC WIRES.

Owing to the vast amount of underground excavations now having to be made in New York City in building the new subway lines, which extend for many miles, the electrical engineers of the telephone and power companies have had their hands full in taking care of the continual shifting and rearrangement of the hundreds of underground cables and wires used for telephone, light and power service.

The illustration we present herewith shows a section of Dey street where it intersects with Church street, in New York City. In the foreground may be seen one of the telephone cable manholes, in the process of reconstruction. At the left of the picture may be observed a myriad of electric power and other cables. It is astonishing to the uninitiated who, for the first time, happens to behold one of these exposed sections of a New York thoroughfare, when he observes the tremendous amount of underground wires, cables and pipes which seem to intertwine and pass each other like so many huge snakes. The magnitude of this task becomes more apparent when it is considered that there are often a dozen different voltages, both high and low, being carried by these various cables and wires, and, also, the pipe lines which pass and repass these electric lines contain gas, live steam and water. Besides this, there are the huge sewer lines. All of these various transmission cables and conduits have to be invariably rearranged and shifted about in the construction of the subway, even to different levels, or from one side of the street to the other.



Showing Vast Net Work of Electric Gas, Water and Steam Conductors in a New York City Street Exposed During Building of New Subway.

DR. DE FOREST TO HELP DETECT ZEPPELINS.

A middle-aged American inventor with an electric bulb arrived in London recently on a hurry-up call from the British Government to show Sir Percy Scott how the British capital may avert danger from Zeppelins. And when the American inventor has done his work in London he will cross the Channel to devise a system of protection from air attack for the treasures and the lives of Paris. The inventor is Dr. Lee de Forest, of New York City.

As our readers are well aware, Dr. de Forest is the inventor of the Audion amplifier, an adaptation of the incandescent electric light, by which feeble electric impulses can be magnified to a point at which they can be registered with considerable force.

For several months England has used for coast defense a system of microphone detection against submarines by means of which the vibration of the propellers of German submersibles was picked up by microphones at sea and transmitted to a base, so that the approaching submarine could be located. This defense has been credited by London with being responsible for the destruction of many submarines. In this plan an instrument fashioned on the principle of the Audion was used to magnify the impluses recorded by the microphones at sea, but that form of Audion was not perfected to the stage of Dr. de Forest's recent inventions.

The effectiveness of the coast defense system suggested to the English authorities a similar plan for defense against invading airships. But conditions were different from that of dealing with submarines, because microphones could not be placed high enough in the air to record the vibrations of the propellers of approaching Zeppelins. The success of the de Forest Audion was brought to the attention of the British authorities, and they sent for the man who had invented it to come over and make their protective system work so that London could sleep in peace.

The detection system which Dr. de Forest proposes to work out is as follows: Several delicate microphones are placed on a geometrical figure, probably each on a mast. These microphones are equipped with Audions so that any vibration reaching them is magnified several hundred times, each of the Audions being of the same recording power. The microphone on that point of the geometrical figure nearest the approaching airship will record vibrations of a greater strength than the microphone on the most distant point of the figure. The effect of the vibrations upon the intermediary microphones will, of course, be of varying force, according to the relative distance of the microphone from the source of the vibrations, the approaching airship. From the varying effects of these vibrations on individual microphones is calculated the line of direction of the approach of the vibrations on each microphone. These lines of direction when extended form the outline of an imaginary cone, at the apex of which will be found the approaching airship.

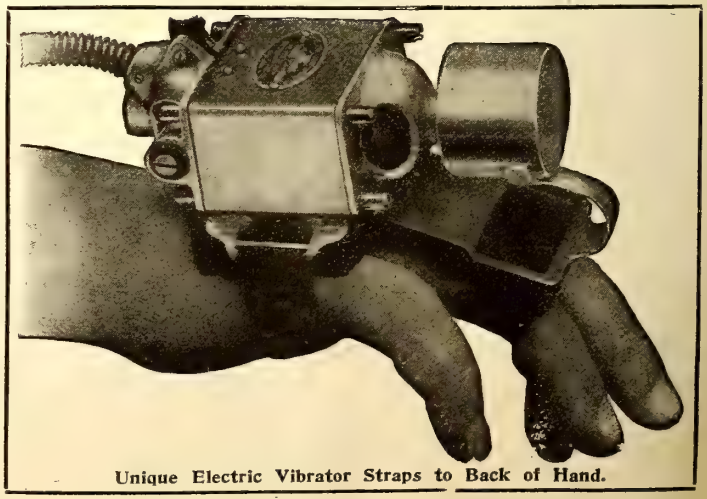
When the location of the airship has been determined, Dr. de Forest's task ends, and that of the aeroplanes and airship guns begin. It is planned to send aeroplanes out above the dirigibles after the location has been determined.

GIRL RADIO OPERATORS.

No girls have as yet qualified as licensed radio operators in this country, although it is stated unofficially that hundreds of girls are transmitting messages in amateur stations controlled by their licensed brothers. Many French girls have qualified as wireless operators, and are now in active service in the war zone.

NOVEL ELECTRIC VIBRATOR STRAPS ON HAND.

A very neat and efficient type of electric massage vibrator is shown in the illustration and, as perceived, it can be strapped to the back of the hand. The vibrations from the device may thus be transmitted through the hand to the face of the patient, etc. It is of great use to barbers and facial specialists. It is supplied for 110-volt direct-current or alternating-current circuits, and comes complete with flexible cord and attachment plug, which may be inserted in the regular lamp socket. Undoubtedly this is one of the smallest practical massage vibrators of the electric type ever devised and one that will appeal to everyone interested in any way in this art.

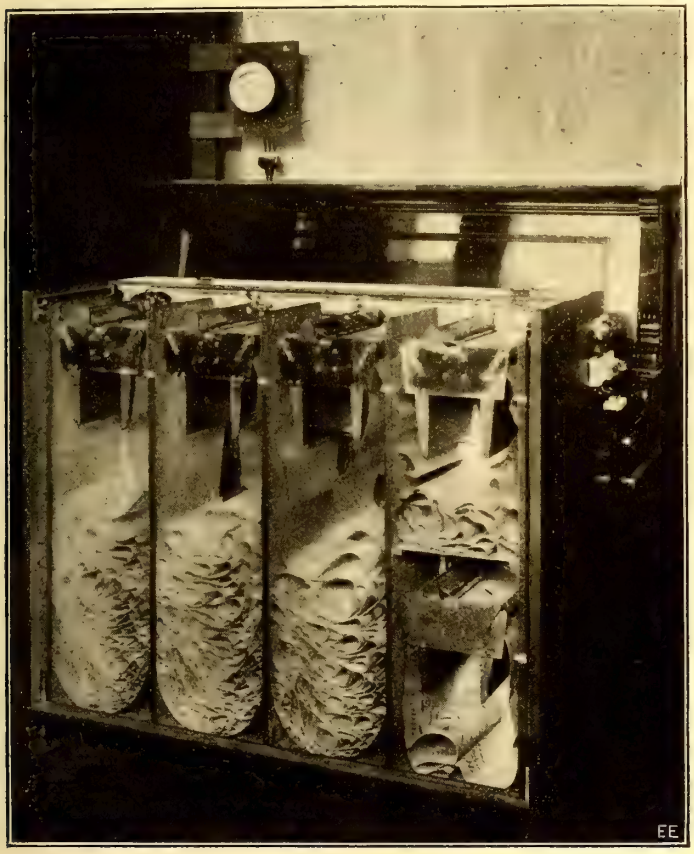


Unique Electric Vibrator Straps to Back of Hand.

A REMARKABLE ELECTRIC PIANO PLAYER FOR THE "MOVIES."

By Frank C. Perkins.

The accompanying illustration shows the mechanism of a wonderful electric piano player, controlled from the film booth by a series of buttons. By the use of sets of endless perforated rolls the movie operator is enabled to instantly change the type and tempo of music from the rear of the house without any other attention to the piano. Bellows are eliminated by a series of electrical contact points which actuate hammers that play on the keys.



New Electric Piano Player, Designed to Replace Orchestras and Capable of Accurate Control by "Movie" Operator.

This electric piano player makes possible the instantaneous change from one piece of music to another at any moment and is particularly adapted for playing pianos in moving picture theaters, eliminating the services of the pianist and the disadvantages and annoyances incident thereto.

It will be seen that the player is placed before the piano, the latter remaining in its usual position before the picture screen, and is controlled by the moving picture operator from his booth by means of a simple electrical controller. The musical program embraces crescendo and thunderous music for battle scenes and the like, allegretto or fast, lively music of various character to correspond with animated scenes such as horse or automobile racing, moderato for social or dramatic scenes, diminuendo, or slow music to coincide with pathetic or sentimental pictures, Indian music to make American Indian action more realistic, staccato chords for highwaymen or burglar action, the music produced having automatic expression.

It is stated that in addition to the above musical effects the more expensive machines are equipped with elementary apparatus controlled by the picture operator for producing battle chaos, shooting, thunder, lightning and wind. Instantaneous changes from one selection of music to another with change in tempo, at the instant the scenes are shifted on the screen, is a most important factor for the successful display of a film.

It is pointed out that in this the ordinary piano player is deficient and the effects desired are oftentimes spoiled. The common automatic piano is almost worse than useless for the picture theater on account of lack of music control, for it may play "Onward, Christian Soldiers" while burglars operate, tango music for a battle scene or a waltz for a funeral.

It is, of course, apparent that the right music at the right time and in the right time, is most vital for the success of the motion picture house; for without it the proper effect of the pictures is nullified which means eventually the loss of patronage.

It is held that with the new player installed to operate the piano, the musical program is directly under the control of the picture operator as it should be and at his will *the music changes instantaneously* on pushing a button, even to the breaking off of playing one selection at any note, and the beginning of another of different tempo the next second—so flexible is the electric current in connection with this mechanism. It is thus possible at all times to have melody to correspond and be consistent with each picture shown.

DAILY NEWS RADIO NOW GOES TO NAVY IN DISTANT WATERS.

Even the oldest inhabitant of Port-au-Prince, Hayti, cannot remember the time before now when the tropics received the baseball scores every evening.

Somehow one doesn't associate the thought of the blue Caribbean and scorching semi-equatorial sunshine with the thought of "New York, 4; Pittsburgh, 6." But it's an actual fact, just the same.

Secretary Daniels has been bitterly assailed as the man who took the Demon Rum out of the navy. But the officers and men in Southern waters bless his name as the man who gave them baseball scores every night.

Not only baseball scores, but the latest word about the Kaiser and the war and William Jennings Bryan's latest opinion penetrate the tropical evenings. The officers and men of Uncle Sam's warships in West Indian waters are now able to learn of the things going on at home and abroad.

Every night the day's news is boiled down to 200 words—just as it should be, someone says—and is telegraphed to the naval wireless station at Key West, Fla. Then the wireless sparks begin to sputter and out over the Gulf, the Caribbean and the South Atlantic flashes the news "from home."

Capt. W. H. Bullard, Superintendent of the Naval Radio Service, is the man who conceived the idea, and through his suggestion Secretary Daniels obtained the co-operation of the news agency and the telegraph company. Only officers and sailors who are thousands of miles from home, in strange waters, by strange shores, can fully appreciate the value of a service of this kind.

Not long ago some 300 jewelers informed Secretary Daniels that they had equipped themselves with radio apparatus just to catch this twice daily time flash from Washington. Time signals are said to be of immense benefit to vessels on the high seas, which now possess for the first time an accurate means of checking their chronometers, which is of the greatest help in fixing longitude.

As soon as the new wireless section in the Philippines is completed it is believed that an interchange of messages between the Philippines and the United States can be made in 30 minutes.

WOMAN MAKES TELEPHONIC INVENTION.

Knowing nothing of the workings of electricity or the telephone, but living daily with a paralyzed husband and mother, who in her absence could not lift the receiver to answer the 'phone, a Memphis, Tenn., woman has invented and patented an appliance to the telephone which enables one to talk and hear without using the hands at all.

The appliance is on the order of a phonograph horn and the connection is made by pushing a little button which is mounted on the stem of the 'phone. This can be done with a pencil held in the teeth if necessary, and the connection once open, the sound may easily be received and sent 15 feet away from the device by talking in a moderate tone of voice.

This combination 'phone will be especially desirable in hospitals or with invalids who have no use of their hands, as they may talk and hear with the greatest ease.

This appliance also enables one to cut out the branch 'phone in the house, as the instrument placed on the landing or stairway with string attached to button enables one to answer calls and hear perfectly without going upstairs or down.

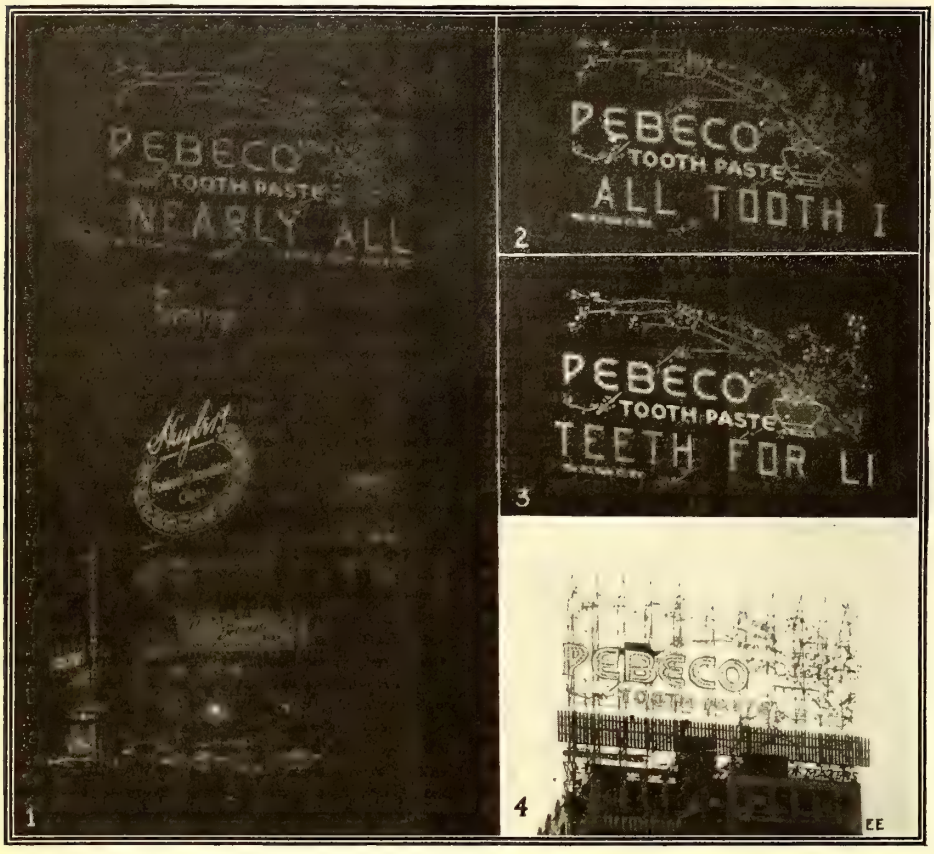


Telephonic Loud Speaking Device Invented by a Woman.

The newest patent for the "Hatch Combination 'Phone" is the collapsible horn and the sound intensifier; by the use of the former the 'phone has the appearance of an ordinary instrument, and by putting it over the lips and using the intensifier properly one may carry on conversation as privately as if he were in a sound-proof booth.

Marvelous Electric Sign that Actually Spells

A RECENT innovation in the multitudinous array of electric signs appearing along the "Great White Way," otherwise known as Broadway, New York City, is that advertising "Pebeco" tooth paste. The illustrations herewith show four distinct views of this extremely novel advertising attraction which, of course, is only to be seen at its best at night time.



Changing Night Effect and Daytime Appearance of New Electric Sign in New York City that Spells Out Successively Continuous Sentences.

The sign is a large affair, measuring about 100 feet long by 50 feet high, and it is supported on a steel framework mounted on top of the Hotel Hermitage near Forty-first street and Broadway in the metropolis. The upper part of the sign does not possess any remarkable features, as may be seen by carefully looking over the illustrations herewith. At the bottom of the sign, however, as becomes noticeable in Fig. 4, is a band about 12 feet high and which extends clear across the face of the sign. This band (which is stationary) is made up of a series of narrow strips, on which are mounted vertical lines of electric bulbs. By a very ingenious flasher arrangement, due to the engineers of the O. J. Gude Co. and on which it is understood patents have been issued, it is made possible to cause a letter, a word or a sentence to flash across this normally black band from right to left, i. e., it is spelled out in front of the spectator's very eyes, the letters apparently forming at the right and slowly traveling across the face of the sign, each letter being followed by its complement in forming a word, etc.

This sign has attracted greater crowds than probably any other like advertisement ever erected on Broadway for many a day. It is so unique that it is bound to catch the eye of nearly every passerby, no matter how much in a hurry he is or how intent on his business.

Complete sentences are spelled out in this way, but of course only a section of the sentence, as two or three words appear in the course of a couple of minutes, while the letters form at the right and move across the sign, so to speak.

To more clearly illustrate the action of this highly ingenious sign we may glance at Fig. 1. Here we see the words "nearly all," which form part of a Pebeco advertisement sentence. To start with, only the "N" is observed, and this is formed at the right and gradually slides over toward the left, the E—A—R, etc., following each other consecutively and in their proper sequence with respect to one another.

One of the best effects obtained with this sign is at the close of a certain sentence when the active part of the display becomes totally dark, when the letters forming the end of the sentence appear to literally slide off into the darkness of the night.

It is understood that the switching control of this spectacular display is arranged somewhat on the order of a player-piano, with perforated paper roll, which passes through a special switch arrangement in a manner which becomes apparent to any electrician. A vast amount of work is necessitated in designing, installing and operating such a display, and this is more clearly emphasized when we consider that practically every lamp in the active (spelling) part of the layout has to have a wire brought from it to the switch-control booth on the roof of the hotel. Most of these elaborate sign effects require a staff of several electrical experts to operate and care for the complicated and intricate switch gear utilized in cutting in and out the proper lights.

The sign is in the theatrical section and, therefore, commands nightly a vast audience.

HEARS JAPAN WIRELESS MESSAGE AT GREAT LAKES, ILL.

Sitting at the desk in the new wireless station at Great Lakes, Ill., at 4.10 o'clock on the morning of Oct. 1 last, G. F. Reiling, one of the wireless operators, heard one of the new stations in Japan, about 5,000 miles distant, talking to Kokoa Head station in the Hawaiian Islands. He also declares he heard a wireless telephonic message from Mare Island, Cal.

That there is no doubt about the efficiency of the new wireless station at Great Lakes is seen by the fact that Reiling gives word for word the message which he heard flashing from the Japanese station, as follows:

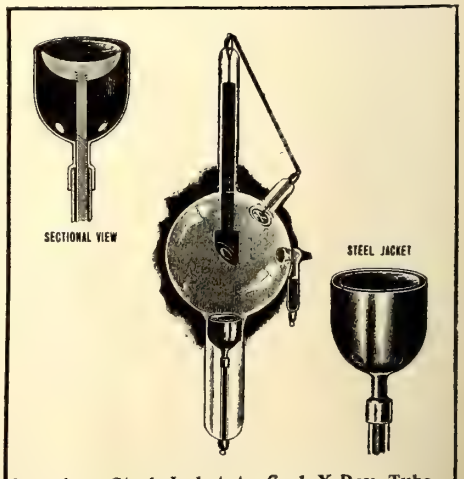
"Hello! Hello! How do you hear me? How are you? What do you want? Please copy: 543210. Do you get this? Please copy (repeats figures) that's all; that's all. Good-bye."

Reiling worked the same morning at 4 o'clock with the San Diego, Cal., station and the operator there told him that the message sent out from Great Lakes station was heard very distinctly. He in turn, at Great Lakes, could hear the California message very plainly.

The Great Lakes station is in daily schedule with San Diego and Arlington, Va., and the clearness of the messages sent so far has caused officials at the station to feel that the local plant is about as efficient as any in operation at any place in the country.

STEEL JACKET CATHODE HELPS COOL X-RAY TUBE.

One of the principal troubles encountered in modern X-ray work and particularly where medium or small sized tubes are utilized, lies in the large amount of heat generated within the tube, and especially at the cathode electrode. In some cases water cooling is resorted to, in an effort to help cool the tube, and electric fans are also employed in a similar effort. It has remained for a western X-ray concern to bring out a very simple device which seems to possess considerable prom-



Ingenious Steel Jacket to Cool X-Ray Tube Cathode.

ise in an effort to reduce the heating in such tubes.

This device, the new Kesselring tube, comprises simply a steel jacket, as illustration shows, which surrounds the cathode electrode proper. The heat produced by the cathode is conducted through the steel jacket and thence along the electrode rod and so out of the tube. This device is of low initial cost and much simpler than many other schemes advocated and employed for this purpose.

High Frequency Currents and Apparata

(Concluded)

AT Fig. 7 is shown how a 16-cp. 110-volt incandescent lamp may be lighted through the body by a high frequency coil. A piece of copper wire is firmly held in the mouth for this somewhat startling experiment and it is also joined to one terminal of the incandescent lamp. A second wire is connected from the other terminal of the lamp to the high frequency transformer. When the proper adjustments have been made on the high frequency set it will be found possible to bring the lamp up to full brilliancy. The Oudin connections are invariably employed for this class of experiments where lamps are lighted, sparks allowed to jump to the hand, etc. A word of caution should be mentioned here, as these high frequency sparks will burn considerably when allowed to jump directly to the skin. In any case, a piece of metal should be held in the hand. No severe shock is experienced in the passage of such high frequency currents through the body as long as they are properly handled by allowing the spark to enter the body through a metal electrode, as stated, and providing the frequency is high enough. Experiments have been conducted where half a million volts were passed through a man's body with several amperes of current. Even with a small high frequency set, lighting a 32-cp., 110-volt lamp, then one ampere of current is passing through the body. With this current, as indicated on a hot-wire ammeter (and which also has the effective current value of one ampere), it is quite possible that it may have an instantaneous maximum value of as much as 160 to 170 amperes. This is due to the very rapid discharge of the condensers in the circuit, and if large enough electrodes are used on the skin no burning effect will be felt.



Fig. 7. Lighting 110 Vt. 16 C.P. Lamp Thru the Body by High Frequency Current.

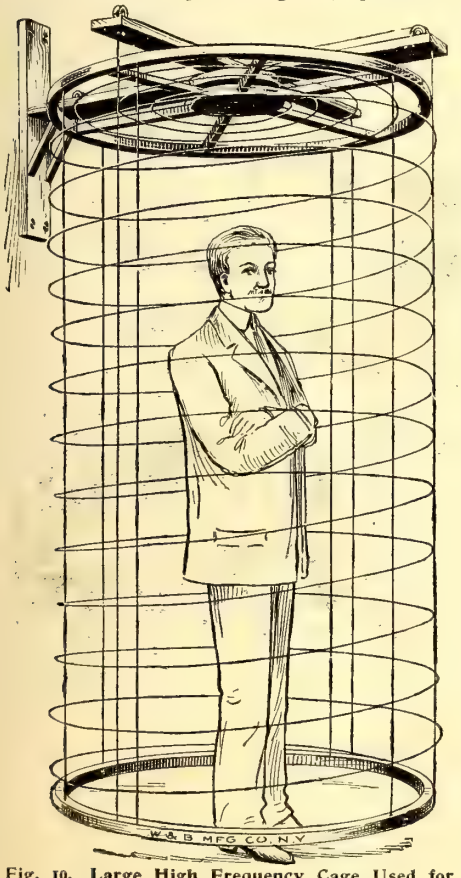


Fig. 10. Large High Frequency Cage Used for Electro-Therapeutical Treatment.

Rather spectacular high frequency discharge effects are portrayed at 8 and 9. These are usually produced by using an Oudin transformer giving a powerful unipolar discharge at high frequency and ultra-high potential. In the experiment at Fig. 9 a metal piece is held in the hand and a flame discharge from same leaps forth into space. The body of the man is here charged at very high voltage by connecting the high frequency terminal of the Oudin transformer to his ankles through a couple of metal ankle straps. He is best seated on a glass platform for this experiment, and all of the adjustments in the high frequency transformer circuit must be very carefully made in order to produce these fine effects, and the inductance of the primary exciting transformer is very important. It is quite advisable, and in fact imperative in some experiments of this nature, to use an adjustable impedance coil in the primary of the exciting step-up transformer, so as to be able to tune it properly with respect to the high frequency circuit. The wonderful effect produced at Fig. 8 is also an Oudin coil phenomenon, and a very fine spray is seen to branch out all around the top of the high frequency coil. This effect is truly marvelous and can only be fully appreciated when observed at first hand. No photograph, and especially a half-tone as here printed, can do justice to the weird and awe-inspiring effect produced in this way. In this experiment a person can approach carefully the highly charged Oudin coil and part of the spray will discharge through the head without any appreciable shock as long as the person does not come too close.

In the electro-therapeutical application of high frequency currents by the medical profession there is often employed a large wire cage of sufficient size to enclose the subject's body as Fig. 10 shows. The high frequency current from an Oudin or Tesla machine is passed through this large helix and powerful currents are induced in the subject's body, and in this way are produced valuable results of an electro-therapeutical nature for various kinds of ailments and diseases. This method is one of the best known to medical science for the treatment of arteriosclerosis, or as it is commonly termed, "hardening of the arteries." Dr. D'Arsonval, the noted French scientist, has made numerous measurements in this direction and has proved by tests on different male and female patients that, after a few treatments of this kind, the blood pressure can be reduced quite markedly, and in most cases permanent lowering of arterial blood pressure is effected.

This large solenoid arrangement can be used to produce spectacular high frequency stunts and experiments, a common one being to let the person inside of the wire cage hold a Geissler tube in his hands so that the current produced in the body will pass through the tube from one hand to the other, lighting up same in a spectacular manner. If the cage is made sufficiently large, two or more persons may stand within same and Geissler tubes placed in their hands so as to complete the circuit from one body, through a Geissler tube, to the next body, etc., giving a very interesting effect for stage and lecture purposes.



Fig. 9. Wonderful Brush Discharge Effect Produced by High Frequency Current.

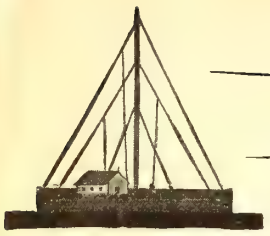


Fig. 8. Another Beautiful and Spectacular Effect Produced by an Oudin Coil.

Many other remarkable and interesting

(*Continued on page* 449.)

Figs 7, 8 and 9, reproduced from "Electricity at High Pressures and Frequencies," by Henry L. Transtrom.



RADIO DEPARTMENT

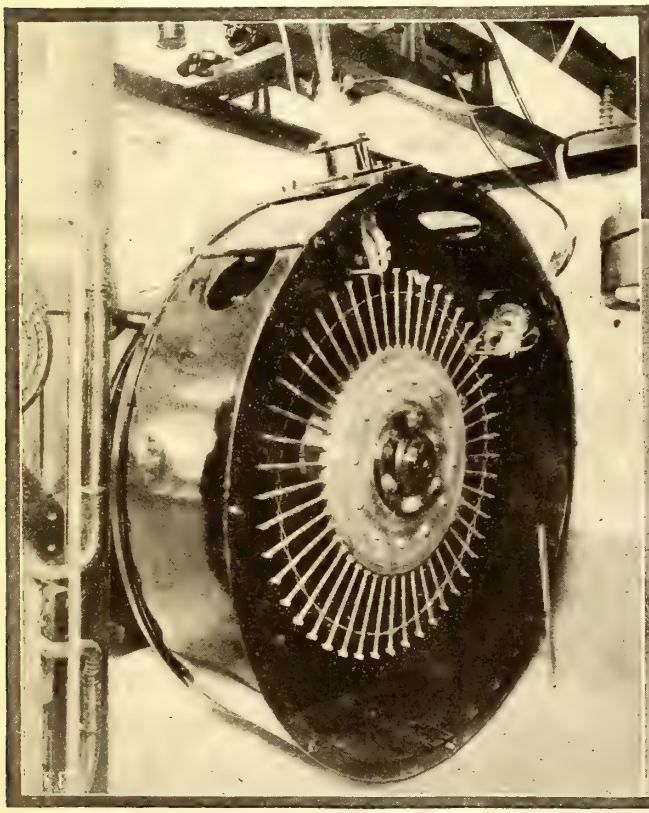


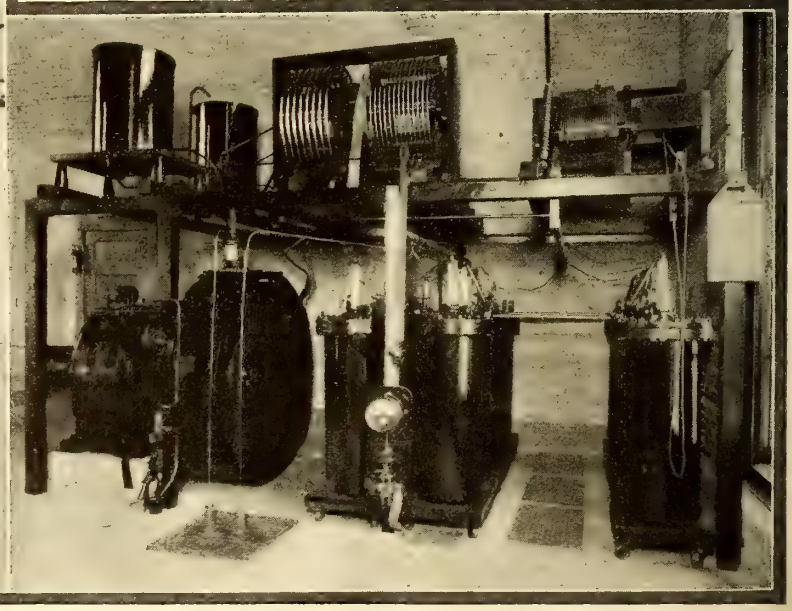
The Radio Transmitting Set at Arlington, Va.

THE powerful Government wireless telegraph station operating at Arlington, Va., and rated at approximately 100 kw., utilizes a synchronous rotary spark gap and a number of other unique apparatus especially designed to handle such a large amount of power in the most efficient manner possible. This installation was supplied by the National Electric Signaling Co., exploiting the patents of Prof. Fessenden. One of the basic patents embodies a synchronous rotary spark gap mounted on the end of the generator shaft or similarly disposed so as to cause the spark to occur in an exact relation at all periods with respect to the reversal of current in the alternating current transformer (primary) circuit. This has been found essential for the best result in any case and is always superior to any non-synchronous rotary spark gap. The two illustrations herewith depict the extra large synchronous spark gap used at Arlington in transmitting time signals, and the other view shows the spark gap itself mounted on the shaft of the 500-cycle alternator, together with the large-size oscillation transformer and aerial loading inductance, as well as the compressed air condensers of the Fessenden type, which resemble steel boilers or tanks, as perceived. The radiation hot-wire ammeter is mounted on the wood post shown in the foreground of the general view of the transmitting set. The tuning oscillation transformer and the loading inductance are very large and are composed of hollow copper tubing. In shifting or adjusting these large tuning inductances, recourse is had to a rope or a belt and countershaft which rotates the drums on which the coils are wound. Electrical contact can be made with any part of a turn as desired by means of a rolling wheel or trolley. This is noticeable, particularly on the aerial loading inductance observed at the extreme right of the photograph.

The rotary spark gap of heroic size rotates at 1,200 R.P.M. and contains two stationary spark electrodes which are fitted with two insulated water cooling systems to help extinguish the spark abruptly, which, of course, is conducive to the most efficient operation of any wireless transmitting set. This rotary gap is enclosed within a guard ring of large size and in which the stationary electrodes of the gap are mounted in extra large insulated bushings. This form of construction has many advantages, and one in particular is that allowing the stationary electrodes to be moved through several degrees with respect to the rotating spark wheel, and in this way the sparks proper can be made to occur at practically any point desired in the alternating current cycle passing through the step-up transformer which charges the condensers and, likewise, this spark gap circuit.

The condensers used with this set, which are, as aforementioned, of the compressed air type, have many advantages over other types employing glass as the dielectric. When a break-down occurs in such condensers as these they possess a self-healing or self-restoring dielectric characteristic, and in operation it is merely necessary to keep the compressed air at so many pounds' pressure within the tanks. The metal tanks are of very rugged construction and the condenser plates within them are suspended from the covers, which are bolted to the tank proper. One set of plates is grounded to the shell, while the alternating plates are connected through a heavily insulated terminal, as perceived from the illustration. This plant is probably one of the most powerful and efficient extant today and the wireless time signals sent out at noon and 10 P. M., Eastern time, daily are now received by thousands of experimental and commercial radio stations throughout the United States, and also by ships at sea in all parts of the Atlantic Ocean. Signals from this station have been received under good conditions at the Eiffel Tower radio plant at Paris, France. It has been stated a number of times that the time signals and weather reports as picked up from the Arlington station are much clearer and more easily read over long distances than those transmitted by the Eiffel Tower station at Paris, or from any other high-power radio station now in operation. This service is of inestimable value to the merchant marine and also to the naval service, enabling the chronometers on board ship to be correctly checked twice each day.





At Left: Close-up View of Synchronous Rotary Spark Gap on 100 KW. 500 Cycle Radio Transmitting Set at Arlington, Va. From this Mastodon Spark Gap Is Sent Out the Radio Time Signals and Weather Reports That Spread Broadcast Over the United States and the Atlantic Ocean Daily.

Below: General View of the 100 KW. wireless Transmitting Set at Arlington. Tanks Below are the Compressed Air, Fessenden Type, Condensers. Water Cooling Tanks for Spark Gap are Seen Over Dynamo. Hot Wire Radiation Ammeter is Observed in Foreground on Post.

Photos Copyright by Underwood & Underwood.

U. S. Army Field Radio Set

THE photographs and diagram herewith show the general appearance and also the connections of the various parts making up the portable radio pack set as used by the U. S. Signal Corps.

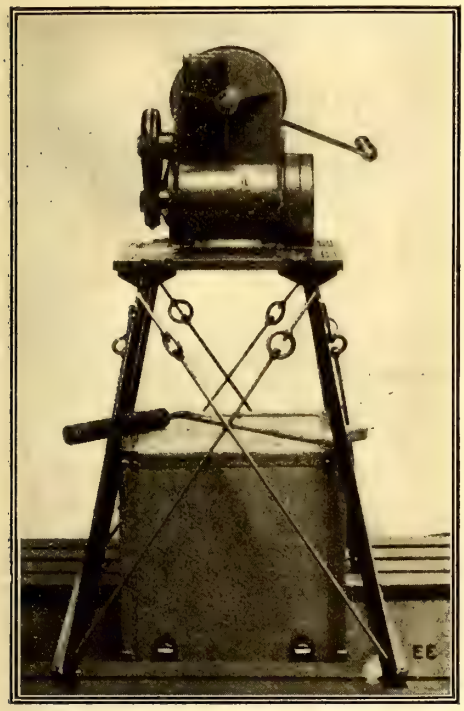


Fig. 1. Compact 250 Watt Hand-driven 500 Cycle A. C. Generator Used to Supply Power for U. S. Signal Corps Radio Pack Set.

The photograph Fig. 1 illustrates the hand-driven dynamo, rated at 250 watts, which can be disassembled in a few minutes so as to be readily packed on a mule's back. Photograph Fig. 2 shows the very compact arrangement of the transmitting and receiving apparatus, including the quenched spark gap, oscillation transformer and loading inductance, the latter being of the flatwise wound ribbon type. These pancake coils forming the oscillation transformer can be swung toward or away from one another, as they are mounted on hinges. On the shelf in the cabinet containing this apparatus is mounted the spark gap, as well as the radiation hot-wire ammeter and the transmitting key. Under the shelf there is mounted the receiving apparatus inductance, and also the step-up transformer of the sending set, as well as the high tension condensers, etc.

Switching means are provided on this set for quickly throwing the aerial and ground terminals onto the receiving or transmitting apparatus. All of the instruments used in the make-up of this outfit are first-class in every particular, the best possible being purchased, as becomes requisite for military requirements.

The small-size hand-driven dynamo utilized in this set can be operated by two men nicely, and is especially geared up with enclosed gears as perceived, so as to give the proper speed when the crank handles are turned at a fair velocity. This style of radio pack set can transmit 20 to 30 miles under average conditions, and can receive over distances of a couple of hundred miles or more in connection with the collapsible mast and antenna wires used in conjunction with it. The whole outfit, including the mast, can be erected in a few minutes' time, ready for service.

Referring to the diagram of connections Fig. 3 as used with this set, they in general follow regular radio engineering practise. As will be evident, there is employed for receiving a switch type loose coupler with primary and secondary windings, and several unique features not commonly found, on experimental radio sets at least, are herewith to be noted.

Among these features is the inductive coupling of the *buzzer test* with the primary coil of the loose coupler. This is arranged on any receiving set very easily by simply winding a few turns of wire around the primary coil or by placing these few turns of wire at the end of the primary, so as to react on same by induction. Another feature which works very nicely, and also one that is invariably used on all commercial radio sets nowadays, is the *safety spark gap* placed across the aerial and ground connections of the receiving apparatus proper. Any heavy static or lightning discharges will jump this gap in preference to passing through the high resistance and reactance of the coupler windings. This indirectly protects the sensitive and expensive head 'phones, as well as the mineral detector. Also in some cases where such protective spark gap were not used it has happened that the coupler was burned out by an extra heavy static surge through the circuit, occasioned by the close proximity of an electric storm while operating the set.

A simple aerial switch effects the change-over from transmitting to receiving set. The transmitting apparatus is very simple and will be readily understood from the diagram. It comprises a primary coil in the oscillation transformer, and this reacts by induction on three secondary spirals, any one or all of which may be joined in the circuit as different wave lengths are required. The quenched gap, condenser and hot-wire ammeter connections are indicated clearly, and the step-up transformer of the *resonance type*, especially designed for this work, is air insulated. Alternating current of the proper voltage and 500 cycles frequency is supplied by the hand-driven self-exciting generator previously described. This machine is fitted with an automatic centrifugal cut-out switch which does not permit operating the set until the proper speed is reached, and consequently the critical frequency produced by the dynamo. This is necessary for several reasons when maximum efficiency is to be attained by such a set, and particularly due to the utilization of the resonance type of transformer incorporated in this design.

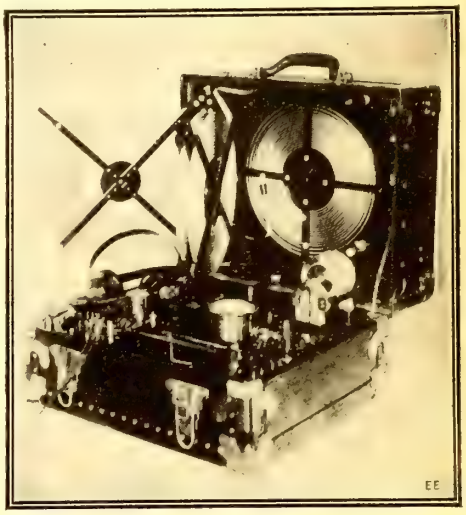


Fig. 2. Showing Neat Arrangement of Complete Portable Radio Transmitting and Receiving Apparatus in Army Pack Set. Note Use of Several "Pancake" Style Helices.

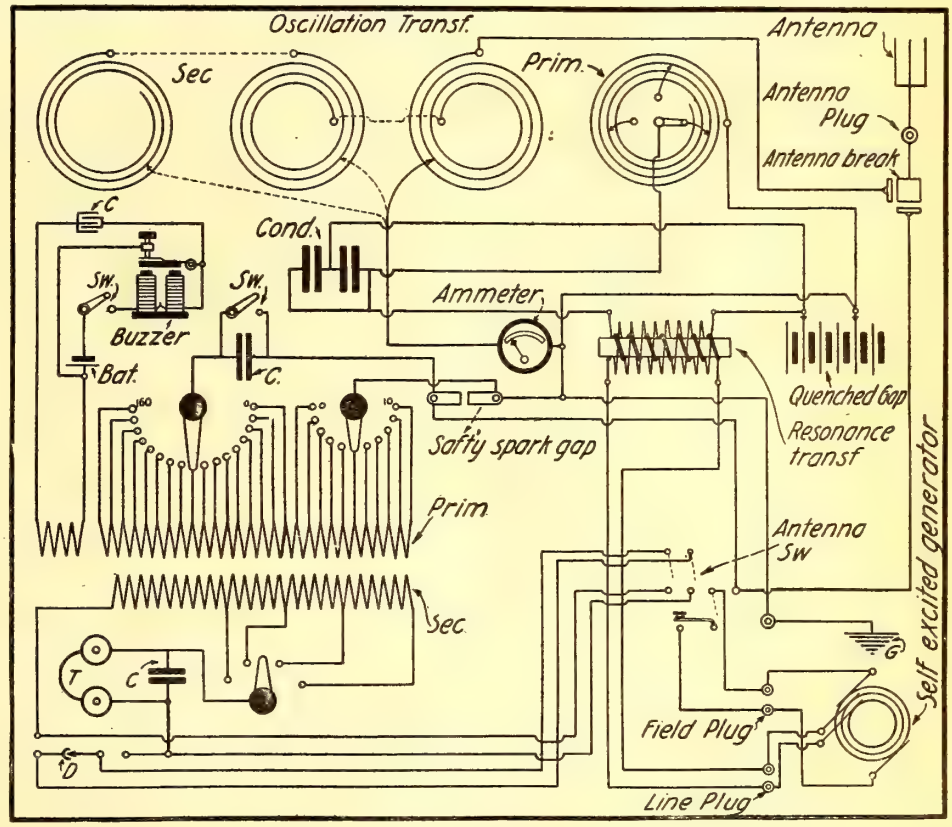
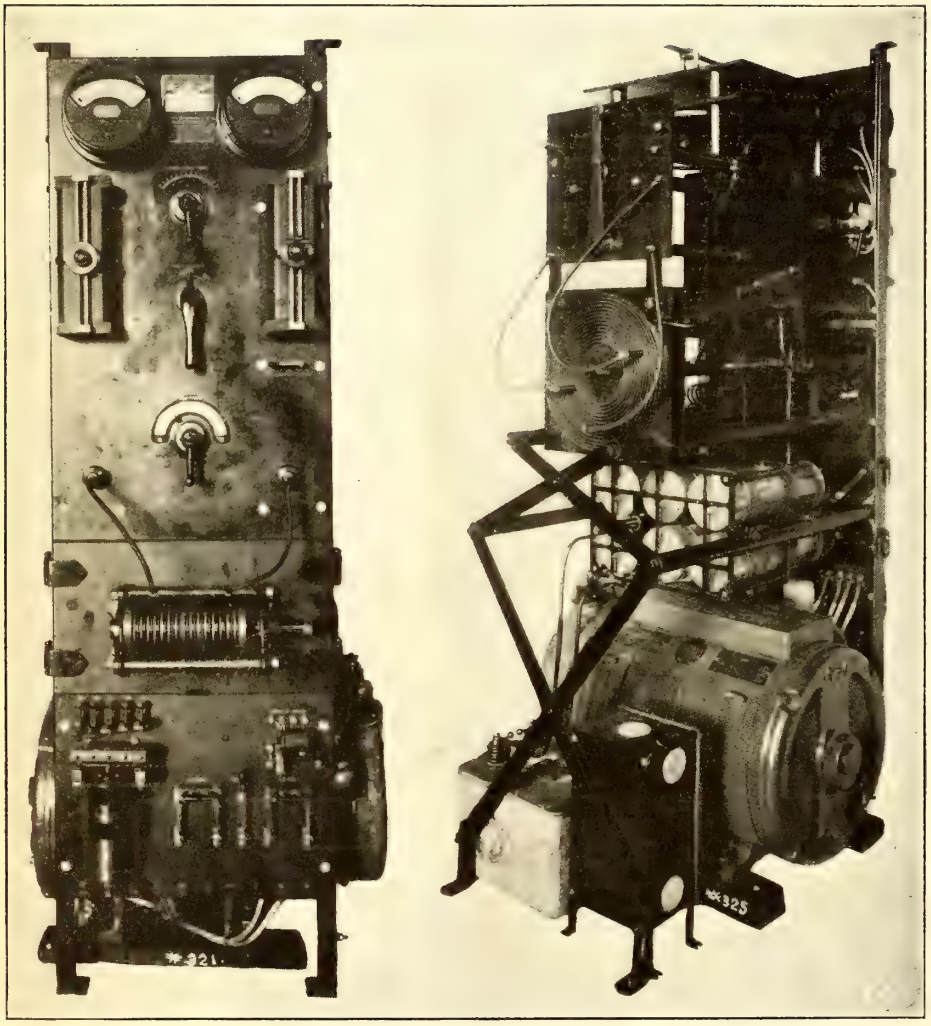


Fig. 3. Diagram of Connections for Transmitting and Receiving Instruments in Radio Pack Set. Note "Buzzer Test" Inductively Coupled.

Marconi Company Develops New 2-KW. Radio Panel Set

The accompanying illustrations show, respectively, the front and rear views of a newly developed 2-kw. radio transmitting set of the quenched-spark type as brought out by the Marconi Wireless Telegraph Co. This set marks the latest advance in wireless outfits of this type. As will be observed, all of the apparatus for both the primary and secondary transmitting circuits are mounted behind the switchboard panel. This conduces to the interchangeability of the outfits for installation on shipboard, and also it permits of using short leads for connecting up the apparatus, and in this way undue losses are obviated.



Front and Rear Views of New Marconi 2-KW. Radio Transmitting Panel Set.

This is a very important consideration in the high-potential, high-frequency circuits.

The motor-generator set is seen at the bottom of the photograph in its cylindrical casing. Above it are mounted, in a special rack, the Leyden jar condensers. Back of the motor-generator set is placed the step-up, high-potential alternating-current transformer, which is provided with a protective spark gap fitted with ball terminals. On the upper rear section of the panel is mounted the oscillation transformer, made up of a spiral copper strip moulded in a special insulating disc, and also a large loading inductance for the aerial circuit used in transmitting long waves is incorporated in this part of the apparatus. The wave lengths are controlled by suitable handles on the front of the switchboard panel, as the illustrations indicate, and these handles are fitted with indicating needles, which move over calibrated scales marked off in wave lengths.

Variation in the coupling between the primary and secondary coils of the oscillation transformer is effected by the control handle and needle, which are mounted directly above the quenched-spark gap.

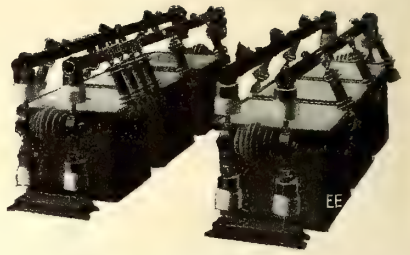
On the lower front of the panel are mounted the necessary motor-generator switches and starting solenoid, as well as overload relay. The usual ammeter and voltmeter for the primary circuit of the alternating-current transmitter are mounted on the front of the panel, as well as slider type rheostats for the field circuits of the motor and generator. This, as will be seen, forms a very desirable and compact set, readily adaptable to ship and other requirements which in most cases permit of very little space for the installation of the radio apparatus.

FESSENDEN INVENTS SUBMARINE RADIO.

Professor Fessenden, of Boston, claims to have invented a contrivance for sending wireless messages from battleships to submarines at a distance of 32 miles under water. By experiments he hopes to increase the distance very considerably. He states that the appliance can also detect the sound of submarine propellers at a distance of two miles, which can be increased to five miles by means of a sound-amplifying contrivance. This, he says, would be useful in detecting enemy submarines.

A HUGE OIL TYPE RADIO CONDENSER.

The large oil insulated condenser herewith presented is of the non-variable type and consists of a large number of zinc plates separated by glass plates. The conducting plates are bolted together in the usual manner. The condenser is placed



Large Size German Make Oil Type Radio Condenser.

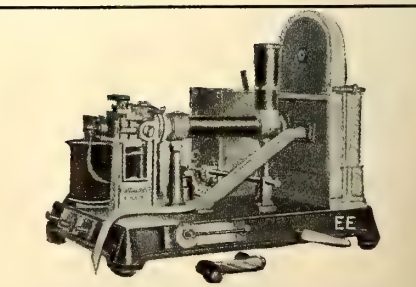
in a container in which oil is used as a dielectric. Each condenser acts as a single unit and any number of them can be shunted across the two metal conducting tubes, as shown above the containers. Each one is properly insulated, as can be observed.

These condensers are now extensively used in the German wireless stations, as they are very reliable. Note that hollow tubes are used to give low resistance for the high frequency currents, which, as we know, only travel on the surface of a conductor.

PHOTOGRAPHING RADIO WAVES.

Various methods have been suggested and some actually developed for recording incoming wireless waves. These were generally unsuccessful, due to the fact that the messages had to be transmitted at a slow speed. Finally a photographic recording scheme has been developed whereby the waves are photographed upon a moving strip of film. This apparatus here shown consists of a camera, a string galvanometer, mechanically-driven photographic film strip and a beam of light from an incandescent electric lamp.

The operation of this instrument is as follows: The galvanometer is connected to the receiving instruments in place of the regular receivers and a beam of light is set upon the mirror of the galvanometer. Now the film is passed before the reflected light of the mirror by starting the mechanical motor. If there are messages in the ether, the galvanometer string will oscillate in accordance with the incoming waves and in turn deflect the reflected light on the film. After the message is finished the film is developed and fixed as in the ordinary photographic process. It will be found that the dots and dashes



Radio Signal Photographic Apparatus, Uses Film.

are all connected in one continuous wavy line.

This method of recording wireless signals is very accurate, durable, and high speed signals can be successfully copied. It was found that 150 words per minute can be readily recorded in this way.

A New Vibrating Reed Radio Amplifier

By Homer Vanderbilt

The greatest desire of the present wireless "bug" is to have some means of amplifying the incoming radio signals to such an intensity that he may remove his head 'phones and still be able to hear; also

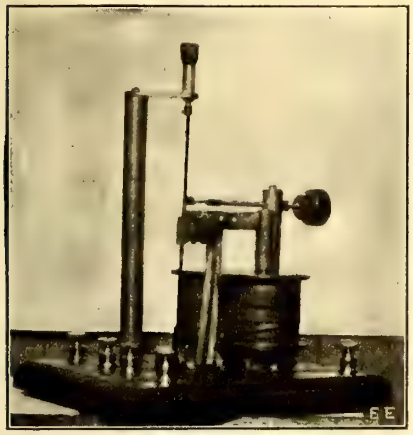


Fig. 1. Photo of Vibrating Reed Amplifier.

thereby making it possible for any interested friends to "listen in" at the same time. Many such devices have recently been developed, but most of them have proven failures, while the cost of others is far beyond the means of the average experimenter.

The amplifier herewith described was developed after some research work, and below is explained briefly the building of the complete apparatus, the photo at Fig. 1 being the completed instrument and Figs. 2, 3, 4 and 5 depicting the construction in detail.

By referring to B in figures it will be noted that two electro-magnets B B are made up from a couple of soft iron cores ⅝ inch in diameter and 8 inches long. A pound of No. 24 B. & S. insulated copper wire is wound on each. The bobbins measure 3½ inches between end cheeks. On one end of each core there are two strips of soft iron L L for supporting the coils C. These coils and their soft iron cores are obtained from a wireless receiver (having 3,000 ohms resistance), and are held in place by means of two No. 8-32 machine screws as shown. The two large electro-magnets are supported on a soft iron yoke P (see Fig. 2).

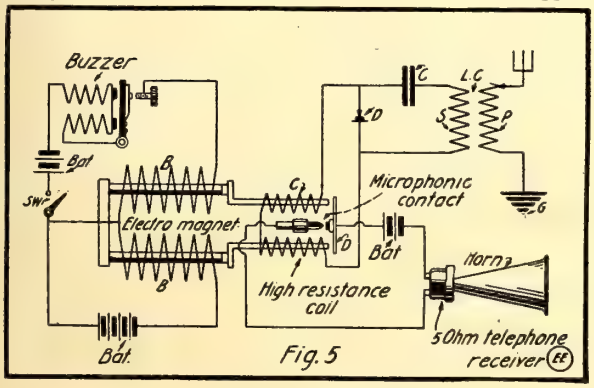


Fig. 5. Diagram for Amplifier.

The armature D, as we see from Fig. 4, consists of a thin strip of soft iron (about No. 34 gauge), cut as may be perceived. A small cup H, made from brass, is now fastened to the armature. This is done, first, by thoroughly cleaning the upper portion of the armature and then copper-plating it, after which the cup is soldered fast and a small polished carbon button is fitted snugly into it.

The armature is supported by two No. 40, or better, No. 45 B. & S. copper wires E E, which are soldered to each end of it. The free ends are fastened to an adjusting attachment G, which consists of an 8-32 threaded brass rod having on one end a small hole for inserting the copper wire E, and the rod G slides through a small tube N. This tube is soldered to the bar M and standard F. The rod F is supported by a square base of wood A, having also a small wire support Q and set screw.

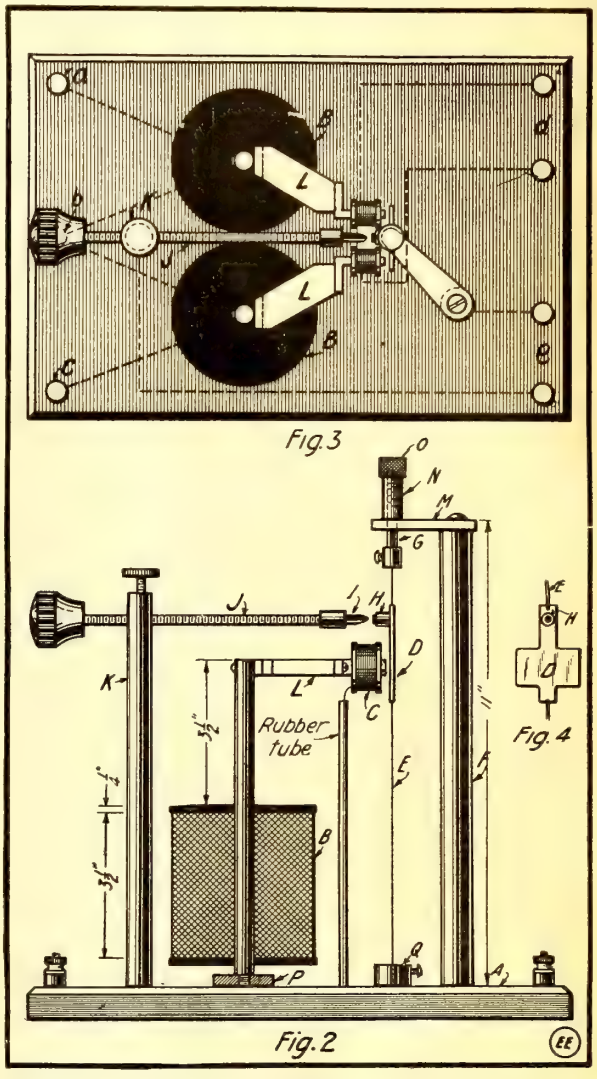
The other standard K supports the second carbon point I by means of an 8-32 threaded brass rod, which is used to regulate the pressure between the carbon electrodes.

As will be noted, seven binding posts are employed, three of which are connected from the electro-magnets, two from the high-resistance coils, while the other two lead from the microphonic points I and H.

Fig. 5 explains the connections of each part and, as is seen, one coil of the electro-magnet is connected in series with a buzzer and battery and the other is hooked up directly across a set of storage batteries giving about 8 to 10 volts. The sensitive high-resistance coils are connected to the regular receiving apparatus in place of the head receivers, while the microphonic electrodes are wired in series with a 5-ohm telephone receiver (having its permanent magnet removed) and a small horn attached to its cap.

The operation is as follows: When the current is sent through one coil the iron armature is twisted and attracted at that point. As soon as the buzzer is operated (which produces an alternating current in the opposite coil) it starts the other end of the armature vibrating. Now adjust the carbon point I by screwing the knob on threaded rod J until a slight click is heard in the receiver. At this point, without touching any part of the amplifier, connect the 3,000-ohm coils to the wireless set. If there are signals in the ether, and picked up by the apparatus, they will be transmitted to the coils C, which will cause a break in the vibration of the armature, due to the alternating current produced in the electro-magnet, which consequently shortens the contact between the carbon electrodes and thereby making the "telephone circuit" complete. This will produce a loud sound in the receiver. By very carefully adjusting the carbon contacts the signals can be readily amplified without any trouble. A good point about this amplifier is that it will not jar or break its adjustment if once set.

It is hoped that this may lead to further research on the part of other radio "bugs" along this line, as the writer's experiments with a rather crudely made model, constructed as here outlined, seemed to possess considerable promise.



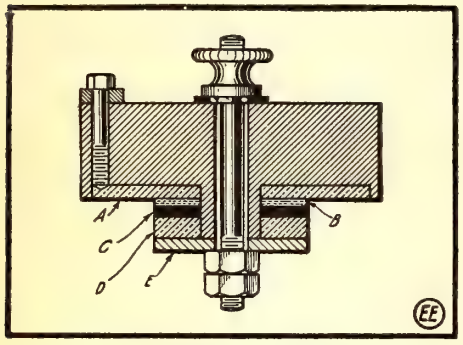
Side and Top Views of Amplifier, Showing Suspension of Reed.

INSTITUTE OF RADIO ENGINEERS PACIFIC COAST MEETING.

On Thursday and Friday afternoons, Sept. 16 and 17 last, joint meetings of the Institute of Radio Engineers and the American Institute of Electrical Engineers were held at the Native Sons of the Golden West Hall, Panama-Pacific Exposition grounds, San Francisco. Two papers for the radio engineers were presented, one on each day. Thursday afternoon Prof. Harris J. Ryan read the results of investigations on the "Sustained Radio Frequency High Voltage Discharge," by Roland G. Marx and himself, taking up the flame and brush types of discharge obtained from conductors when a powerful arc generator is used to apply voltages up to 50,000 at frequencies as high as 200,000 cycles per second. On Friday Robert H. Marrjott, of the United States Naval Radio Service, read a paper on "Radio Development in the United States," giving special attention to Pacific Coast conditions.

THE TELEFUNKEN PERMANENT CRYSTAL DETECTOR.

A form of crystal detector which has been used for some time in the Telefunken radio receiving sets as supplied to various army and navy signal corps, and also in use in the United States Signal Corps radio



Make-up of Telefunken "Permanent" Mineral Detector.

pack sets, has interested undoubtedly more than one experimenter who has seen one of them. The particular reason why this detector is very little known is due to the fact that once it is adjusted and made up in the laboratory it is sealed and is not supposed to be opened by anyone, even the Government operators. We present herewith a diagram showing how this crystal detector is made up, and besides being robust in construction it is also extremely sensitive and compares well with the audion.

Referring to the sectional view of this detector shown herewith, A is a washer serving as one terminal of the device, while B is a plate of sensitive mineral material, such as galena. At C is placed a thin perforated mica disc, while D is a brass, graphite or other washer whose surface next the mica is corrugated and silvered. When sufficient pressure is applied to this device the corrugated surface of D comes in contact with the mineral B, thus providing several rectifying parts for the received oscillations of the radio receptor circuit. The washer E allows the whole to be screwed up tightly, as perceived. No auxiliary battery is necessary for this detector and it is connected into circuit in the same way as the galena detectors, with which practically all experimenters are familiar. Two of these detectors are usually provided in the Telefunken sets and they are connected with a throw-over switch, so that if one should fail for some reason, the second detector may be immediately switched into circuit.

NAVAL RADIO STATIONS.

The opening of the new naval radio station at Darien, Isthmian Canal Zone, adds to the facilities for the transmission of Government messages, but does not extend the commercial service. The Navy Department, in advising the Department of Commerce of the opening of the station, offers to transmit free all official messages to or from points in the Canal Zone from or to points in the United States.

Out of a total of 47 naval radio stations which are now in use in various parts of the United States or possessions 21 are open to commercial messages, while the others are reserved for official business. In the Canal Zone there are two stations—at Balboa and Colon—which receive commercial messages, so that the new station need not enter that field in order to accommodate the public as the facilities are already adequate.

A list of the United States naval radio stations, with their classes of service, is here presented:

Location.	Service.
Annapolis, Md.	Official
Arlington, Va.*	Official
Balboa, Canal Zone	Commercial
Beaufort, N. C.	Official
Boston, Mass.	Official
Cape Blanco, Ore.	Commercial
Cape Cod, Mass.	Official
Cavite, Philippine Islands	Official
Charleston, S. C.	Commercial
Colon, Canal Zone	Commercial
Cordova, Alaska	Commercial
Darien, Panama	Official
Dutch Harbor, Alaska	Commercial
Eureka, Cal.*	Commercial
Farallons, Colo.	Official
Fire Island, N. Y.	Official
Guam, Marianne Islands	Commercial
Guantanamo Bay, Cuba	Commercial
Honolulu, Hawaii	Official
Jupiter, Fla.	Official
Key West, Fla.	Commercial
Kodiak, Alaska	Commercial
Mare Island, Cal.*	Official
New Orleans, La.*	Official
Newport, R. I.	Official
New York, N.Y. (Brooklyn Navy Yard)	Official
Norfolk, Va.	Official
North Head, Wash.*	Commercial
Olongapo, Philippine Islands	Official
Peking, China	Official
Pensacola, Fla.	Commercial
Philadelphia, Pa.	Official
Point Arguello, Cal.	Commercial
Portland, Me.	Official
Port Royal, S. C.	Official
Portsmouth, N. H.	Official
Puget Sound, Wash.	Official
St. Augustine, Fla.	Commercial
St. George, Alaska	Official
St. Paul, Alaska	Commercial
San Diego, Cal.*	Commercial
San Juan, Porto Rico	Commercial
Sitka, Alaska	Commercial
Tatoosh, Wash.	Commercial
Tutuila, Samoa	Commercial
Washington, D. C.	Official
Yerba Buena, Cal.	Official

* Station transmits time signals and weather reports daily.

Besides these the army of the United States, through its Signal Corps, has stations that are open to commercial business at Fairbanks, Alaska; Fort Mills, Philippine Islands; Fort St. Michael, Alaska; Kotlik, Alaska; Nome, Alaska; Petersburg, Alaska, and Wrangell, Alaska.

Plans have been made for radio communication between San Francisco and Manila by way of Honolulu, but work on that project will not be commenced until fall, and the section to Honolulu will not be in operation until a year from this time.

A naval station at Point Isabel, Tex., and Great Lakes Training School Station are under construction.

SPIRAL ANTENNAE FOR RADIO PURPOSES.

M. Bethenod, in *La Revue Electrique*, proposes the antenna arrangement shown

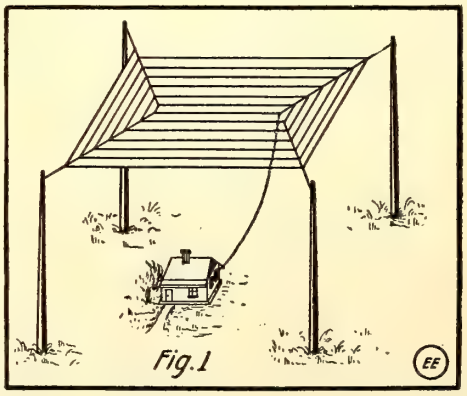


Fig. 1. Proposed Spiral Antennae for Radio-Telegraphy.

in Fig. 1, in which the antenna starts from the station building in the form of a single wire and is then arranged in the form of a spiral, in a nearly horizontal plane, by means of supporting cables as shown in the illustration. Fig. 2 shows an ordinary antenna consisting of 11 wires, the wave length being 3,500 meters, in comparison with an antenna in which the spiral arrangement is employed, the wave length here being 5,500 meters. As will be seen, the construction is much simpler and requires considerably less space. The only inconvenience seems to be that a spiral antenna cannot be used with damped waves on account of the high tension which would be developed between the horizontal conductors.

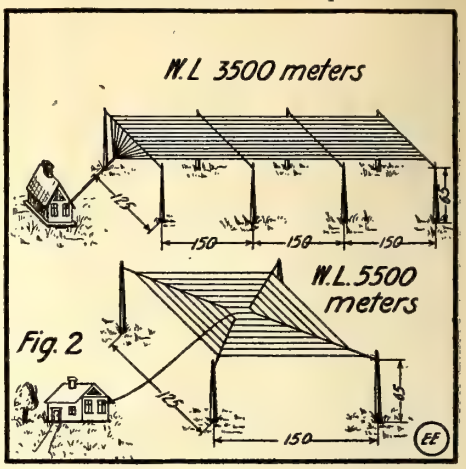


Fig. 2. Comparative Sizes of Spiral and Straight Types of Antennae.

THE RESISTANCE OF WIRELESS ANTENNAS.

A suggested explanation of increase of resistance of radiotelegraphic antennas which has been observed under certain conditions where the wave length is increased has been offered by L. W. Austin in a paper on the subject issued by the Bureau of Standards.

The resistance of radiotelegraphic antennas may be divided into three parts—first, the ohmic resistance of the wires; second, the so-called radiation resistance, and third, the so-called earth resistance.

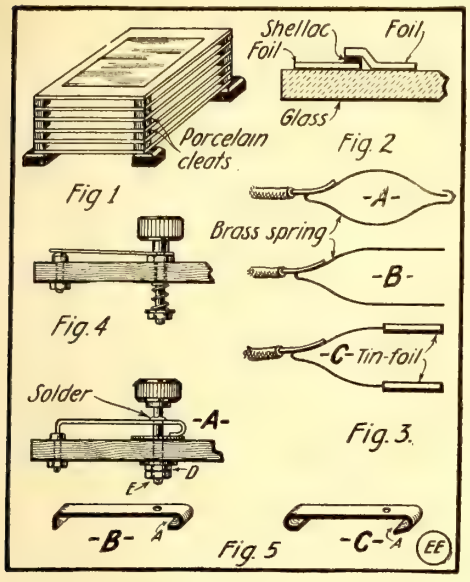
Up to the present no satisfactory theory of ground resistance has been developed. The experimental curves of antenna resistance, on account of the decreasing radiation resistance, fall rapidly at first, as the wave length is increased, and then, as the wave length is further increased, remain nearly constant, if the ground conditions are good, as in the case of a ship's antenna, or again rise nearly in a straight line, if the ground conditions are poor. This rise may be very rapid in the case of peculiarly poor grounds. For instance, the resistance of the Bureau of Standard antenna rises from 13 ohms at 800 meters wave length to 38 ohms at 2,000 meters.

Great difficulty has been found in explaining this increase of resistance with increasing wave length, but it is believed that the antenna system must be looked upon as a condenser, the antenna itself being the upper plate and the ground water the lower plate. Between the ground water and the surface there is usually a layer of semi-conducting material, which would correspond to a poor dielectric in the case of an ordinary condenser. It is well known that the dielectric losses in imperfect condensers generally increase in proportion to the wave length of the current employed in the measurement. It is found that by covering the surface of the ground under and around the antenna with a wire net, thus making the lower plate of the condenser, ground losses nearly disappear.

Don't nickelplate your instruments. It increases the high frequency resistance and lowers the tuning efficiency.

SOME WIRELESS KNICK-KNACKS.

Very few amateurs care to invest in the hard-rubber support necessary when building efficient high-tension condensers. A good method is to build them as in Fig. 1. The plates are simply stacked one on



Useful Wrinkles for the Wireless Man.

top of the other, using porcelain cleats for separators.

I have visited quite a few amateur radio stations and it is surprising to learn how many experimenters tolerate brush discharges in their condensers. Some of them paint the edge of the foil with shellac, but this soon breaks down, due possibly to the shellac cracking when drying out.

The best plan is to dip the edges of the glass plates in hot paraffine until a quarter of an inch of the edge of the foil is coated; when dry and hard, dip again quickly (to make a thicker coat) and you will have no brush discharge. Your hot wire meter should now show a higher reading. It is well to construct a pan for coating these plates. The size of the pan will vary with the requirements of each amateur—a good size measures 18 inches long, 2 inches wide and 3 inches deep. A piece of "tin" for the purpose may be obtained from a clean five-gallon gasoline or kerosene can, which, when opened at the seams and bent to shape, will prove big enough for a large-sized pan.

When pasting the foil on the glass it i best to coat the glass with shellac, b oil or other binder and then paste th on the glass, for if the foil is first and pasted the shellac forms an insulato between the foil sheets where they overlap (exaggerated in Fig. 2 to make Of course, the foil might touch in more places, but this is insufficient for a quick discharge—a positively necessa tion, since the law requires "sharp"

Sometimes you will find that the of the contacts touching the foil is quate, and quite often it would arc at the contacts, burning holes which quickly enlarge and necessitate entire rebuilding.

These condenser contacts should made of ⅜ or ½-inch wide spring brass or copper ribbon 1/32 inch thick and bent to shape as in Fig. 3, A or B. At least they should be made of some flat metal and even then it is an excellent plan to wrap some scrap tin-foil about the where it comes in actual contact w condenser foil; Fig. 3-C will ma clear.

Very often a "sputter spark," pro in the gap when seemingly a sharp spark should be the result, is due to these faults in construction as explained above, and a change in such a small matter may make the set highly efficient. Like all other things, a wireless set is "no better than its weakest spot."

I was called on one time to look over a wireless receiving set which from all appearances should have given excellent results, but which was very unsatisfactory. After testing aerial, ground circuits and insulation, I found that the trouble was in the tuning coil. With unthinking zeal and haste, characteristic of the average amateur, he had painted the coil with some black enamel rich in carbon. I am not sure as to whether the turns were actually shorted, or if the trouble was due to the inductive effect. At any rate, when the coil was rewound with new wire, the set "got" long distance.

Another time I "shot trouble" for an hour before the trouble narrowed down to the detector. The crystal itself was good before and after mounting, for it has been tried in the test clamps.

The detector itself was a beautifully polished brass and marble affair and truly was a thing of beauty. We hooked up the detector in series with the battery and 'phones, and on withdrawing the point from the crystal the 'phones still showed a *short*. On dismantling the detector we found—with battery and 'phones—that there was an invisible vein of mineral from one post to another, running through the marble. All the holes in this detector were rebored a little larger, bushed with hard rubber, and it has given no trouble since.

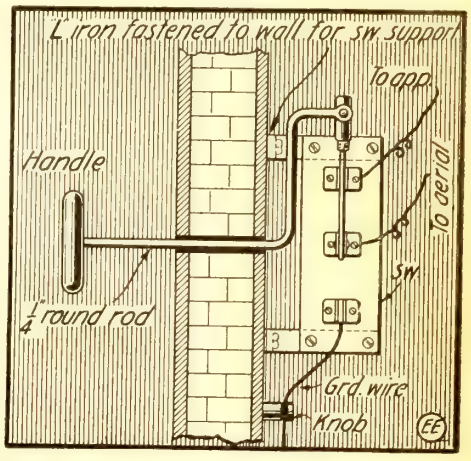
It is a good plan to bush all holes in marble bases, especially in high-tension switches. This course is usually unnecessary with manufactured apparatus for the imperfect ones are discarded, though I know of two instances where the purchased detector "leaked," and was repaired by the above method successfully.

In making radial arm switches for tuning coils, detectors, etc., it is a common practise to use simply a straight strip of brass or copper for the arm, with the necessary tension obtained by the use of some form of spring, usually a spiral spring inside of the case or switch, as in Fig. 4. The arm with this form of construction is never level and seldom looks well. A far better-looking, better-acting and much simpler plan is shown in Fig. 5. Bend the spring brass arm to the shape as in the figure at B or C. The end A will be [illegible] below by the nut D, Fig. 5. The lock nut E will hold things permanently.

Contributed by
[illegible] H.L.K.

A CONVENIENT LIGHTNING GROUND SWITCH.

"In cases where the aerial is—permanently and effectively grounded at all times when the station is not in operation, by a conductor not smaller than No. 4 B. & S. gauge copper wire, run in a direct line as possible to water pipe at a point on the street side of all connections to said water



Controlling Out-Door Lightning Switch From Inside of Building.

pipe within the premises, or to some other satisfactory earth connection—the switch to join the aerial to the ground connection shall not be smaller than a standard 100-ampere knife switch."—From sections a and d of Rule 86 of "Rules and Requirements" of the National Board of Fire Underwriters."

Some radio amateurs are not aware of the above fact and others are sadly so because the location of the ground switch often indirectly locates the apparatus in a place which is not as well suited for it as some other. To move the apparatus away from the lightning switch often increases the wave length, so that to keep within 200 meters the amateur must shorten his aerial or use the ineffective series condenser.

The only things required besides the switch are two iron angles, about two feet of one-quarter inch round iron rod, a round wood radiator valve handle and a few screws and bolts. Nearly all of these can be obtained from any hardware store.

A hole large enough to allow the iron shaft to freely turn is drilled in the side of the house and the shaft put through the hole and bent so that the end can be screwed to the switch handle. The location of these screw holes is then found by ing the switch upon the angles with the ge screw in front of the hole in the

fter drilling the holes and fastening the rod to the switch handle the shaft is then put through the hole and the switch screwed fast, as shown. The control handle is then fastened to the inside end of the shaft with a screw or pin and a small indicator put on. It may be necessary to loosen the hinge screw to have freer mo- [illegible] housed from

FRANK H. BROOME.

Laboratory Equipment for Illustrating the Principles of Electro-Magnetic, Magnetic, and Electro-Dynamic Phenomena

By Harlan A. Eveleth

THE amateur radio-telegraph operator and electrical experimenter enthusiast does not usually obtain satisfaction by the mere operating of finished apparatus which has come direct to his hands from the display windows of the warehouse; he is—to be successful—of an inquisitive temperament and is forever delving into the mysteries of the unknown in the fervent hope of discovering, by the "cut and try" method, some idea which may have escaped the observation of his contemporary "scientists." Following is a description of apparatus which, because of their simplicity and wide range of adaptability, will enable its possessor to investi-

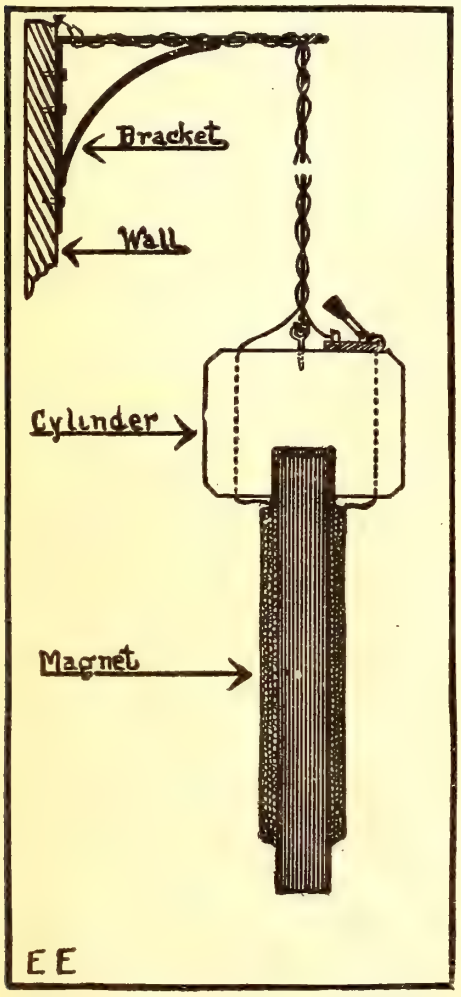


Fig. 1. Showing Suspension of Experimental Alternating Current Electro-Magnet.

gate, to a marked extent, the principles of electro-magnetic, magnetic and electro-dynamic phenomena. Several of the experiments described are exceedingly simple as viewed by the initiated, but all are guaranteed to hold the attention of the uninitiated—the casual visitor to the "laboratory."

core, one inch in diameter by nine inches in length, is composed of a bundle of annealed, soft-iron wires. It is taped for insulation and then, beginning at a distance of one inch from one of the ends, is wound with six layers, 150 turns to a layer, of No. 20 S.C.C. copper wire. The magnet is to be operated direct from the 110-volt, A.C. 60-cycle mains. It is suggested that empire cloth or other insulating fabric be interposed between the various layers, and that the final layer be taped to prevent abrasion of the insulation.

The magnet should be suspended vertically from a bracket fastened to the wall of the room, and a means must be devised for attaching the cord, by which it hangs, to the upper end of the core. A simple way of doing this is to turn a cylinder of wood to a diameter of about four inches and a length of three inches. Bore a hole at the center of one end of the cylinder to a depth of one inch, and of a diameter which is slightly greater than that of the taped end of the core. Spread glue over the taped core and then force it into the hole in the cylinder and secure it by wooden wedges driven in about its circumference; when the glue has set the cylinder will be securely fastened to the magnet. The whole can now be suspended from the bracket by a stout cord tied to a screw-eye set in the upper part of the cylinder. A switch of some sort should be inserted in the circuit, and it may well be placed on the top of the cylinder near the screw-eye. The feed wires may be entwined about the cord and bracket and then led to the power mains. The consumption of current will vary according to the load placed upon the magnet, but the greater part of the experiments will require but a fraction of a kilowatt.

EXPERIMENT No. 1.—To illustrate electro-magnetic repulsion of an A.C. magnet pole.

If possible obtain a solid copper ring of two inches internal diameter and three-quarters to one square inch sectional diameter; see Fig. 2. A satisfactory ring can be constructed by forming a coil of bare copper wire; wind the coil to the dimensions specified and bind by winding the last few feet radially. A ring formed in this manner by the writer was wound with No. 14 bare copper wire and weighed 1½ pounds.

Steady the magnet with one hand and with the other grasp the copper ring and raise it vertically over the magnet. The electro-magnetic repulsion is so great that

EXPERIMENT No. 2.—To illustrate the heating effect of Foucault or "eddy" currents.

Grasp the ring with a pair of tongs and hold forcibly at a point of maximum repulsion. The ring, notwithstanding its large cross-sectional area, will heat rapidly

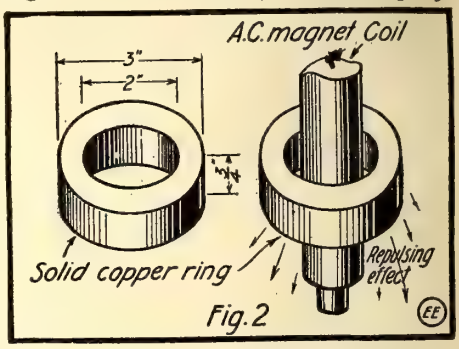


Fig. 2. Demonstrating Repulsion of Solid Copper Ring from A. C. Magnet Pole.

and if left long enough will become red-hot. Care should be exercised so as not to char the insulation of the magnet winding. Lumps of solid iron attracted to the core will heat perceptibly, thus showing the necessity of employing laminated cores in alternating current machinery.

EXPERIMENT No. 3.—To illustrate continuous rotation from electro-magnetic repulsion, or electro-magnetic attraction.

Wind a coil of wire on a form, or "pie," having an internal diameter of 2¼ inches, an external diameter of 5¼ inches and a width of ⅞ inch; the rectangular cross-section of the coil will thus measure ⅞ inch by 1½ inches. About two pounds of No. 26 S.C.C. copper wire will be required. Tape or bind with cord to preserve its form.

Procure two aluminum discs, 6 inches in diameter and of $\frac{1}{16}$ inch gauge. Drill a small hole in the center of each and pivot so they will revolve in a horizontal plane with little friction.

Energize the magnet; then hold the discs,

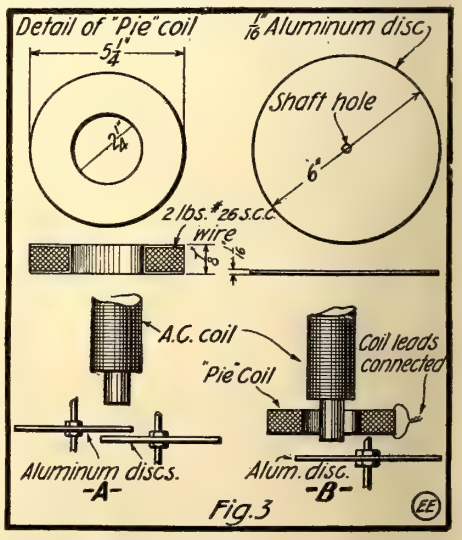


Fig. 3. Apparatus Used in A. C. Rotating Disc Experiment.

partially over-lapping, one about half an inch below the other, Fig. 3 A, beneath the magnet in such a position that the end of the core is above a point on the upper disc, which is about 1½ inches back of one of the two intersections of the peripheries of the discs. The discs will rotate in oppo-

site directions. If one disc is held the other will rotate with greater torque.

The rotation of one of the discs can be shown more lucidly by employing the coil of wire, see Fig. 3 B. Slip the coil over the core (it being understood that the magnet is hanging vertically in this experiment) until the bottom of the coil and end of the core are in the same plane, then hold the disc so that about three-quarters of its surface is beneath that of the coil. The disc will rotate in an opposite direction—if held in the same relative position to the magnet—to that of the first case, and will attain a speed of approximately 300 r.p.m. The terminals of the coil should be short-circuited.

EXPERIMENT No. 4.—To show the shape and intensity of the magnetic field around an A.C. bar magnet.

Form a coil of 50 turns of No. 20 S.C.C. copper wire and connect terminals to a discarded telephone receiver, as in Fig. 4. Do not use radio-telegraph receivers which are valued as such, for a strong alternating current is to be induced in the coil, which tends to weaken the permanent mag-

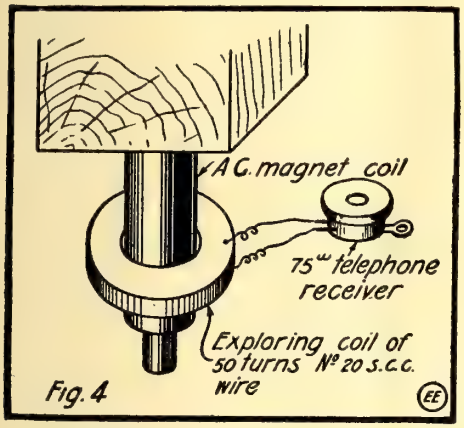


Fig. 4. Exploring Coil and Telephone Receiver for Ascertaining Shape of A. C. Magnetic Field.

net. The magnetic field surrounding the alternating current magnet can be explored and its shape and intensity roughly determined by noting the strength of sound which comes from the receiver as the coil is moved about the magnet. The coil should be kept in a horizontal plane throughout the experiment.

Another method is to employ the coil used in Experiment No. 3, with its terminals connected to a 110-volt lamp. Care should be taken not to burn the lamp out. The induced current from this coil can also be taken through the body without discomfort.

EXPERIMENT No. 5.—To illustrate the principles of the transformer.

Two coils should be wound which will slip easily over the magnet; the first of 10 turns of No. 4 bare, copper wire, and the second of a great many turns of fine, insulated, copper wire. The current induced in the first coil will be in the order of several hundred amperes and the carrying capacity of different sizes of wire can be shown by bringing them across its terminals. Relatively high voltages can be obtained with the second coil; in fact, the whole will act as a fairly efficient transformer.

EXPERIMENT No. 6.—To illustrate the magnetic effects of an A.C. magnet pole upon different metals.

Obtain strips of iron, lead, copper and aluminum and place each in turn beneath the pole of the magnet. The iron will be attracted while the other metals will be slightly repelled. Substances which are attracted to the poles of magnets are termed *paramagnetic*, while those which are repelled are termed *diamagnetic*.

Place the pole of the magnet within a box of iron brads, then remove the box from its contents. The brads will tend to align themselves in the direction of the magnetic lines of force. Iron filings may be used if desired, but brads are much easier to pick out of the carpet. Take several of the brads and place them end on end at different points on the magnet. They will form magnetic chains and will tend to assume the direction of the lines of force.

Interpose sheets of glass, aluminum, copper and iron between the pole of the magnet and a *paramagnetic* metal held within the influence of the field. The sheet of iron will shield the object from the effect of the magnet while the sheets of *diamagnetic* substances will not affect the transmission of force from one point to another, any more than an equivalent thickness of air.

Magnetization may be destroyed or weakened by an excessive rise of temperature. If an iron wire be heated to redness and held beneath the pole of the magnet there will be no attraction between the two. At a temperature of 750 degs. C., known as the critical temperature, iron becomes non-magnetic, but upon cooling it becomes magnetic although completely demagnetised at this stage.

Ingenious Instruments for Testing Electrical Machinery

A new *field tester*, shown in the illustration, Fig. 1, has been perfected for the special purpose of testing the field coils and armatures of the electric railway type of motors. It is a quick and certain detector of weak fields and faults in armatures. It tests the fields when in the motors or out, as the presence of iron makes no difference. It is not even necessary to disconnect the fields. Armatures are tested for shorts, opens and grounds without raising the leads or disturbing the hoods. This new field tester is very simple and easy to operate. It is operated by direct current from the lighting circuits by simply attaching same to a lamp socket in the car or shop.

When testing fields the readings are obtained by sliding the pointer knob along the scale to the point where two distinctly separate sounds become as one, or continuous. The armature test is a bar-to-bar receiver test with the telephone receiver and contact fork.

Experience shows that weak fields are the cause of roasted armature coils, blistered commutators, flash-overs, sparking brushes, arcing controllers, overloaded power circuits and generators. Hence the value of a good field tester, and especially one such as this, which is capable of accurately testing the field coils when in position on the pole pieces.

Another *field and armature tester*, as seen at Fig. 2, is about to be put on the market by the same company. This instrument was developed to supply the demand for testing apparatus that could be operated by current from alternating circuits and which could be used in noisy places, where too much noise might interfere with the use of a telephone receiver. It does the same work as the field tester above described, but instead of the telephone receiver for obtaining the readings meters with pointer and dial are used. When testing field coils the readings are obtained by sliding the pointer along the scale until both meters read the same. The armature test is a bar-to-bar meter test. The meter is mounted in a convenient position right on the testing fork.

The same concern also supplies an *armature tester*, as shown in the accompanying cut, which was developed to supply the demand for a very simple little device intended for testing armatures only. It is operated in connection with either alternating current or direct current lighting circuits. A hard rubber knob with knurled edge permits changing over from one kind of current to the other. As is the case with the two instruments above described, no batteries are used. It quickly detects and exactly locates shorts, opens and grounds without disconnecting the leads or tearing off the hoods. It exactly locates a grounded bar or coil in less time than it takes to tell about it. It will make a complete test of any ordinary armature in less than two



Fig. 1. Instrument for Rapid Testing of Motor and Dynamo Field and Armature Coils.

minutes. This device is regularly furnished with either the alternating current or direct current adjustable contact fork, or both, as desired. It is a handy and indispensable device for power plants and



Fig. 2. Similar Device to That Shown at Fig. 1, but Utilizes Meters Instead of Telephone Receivers.

electrical repair shops of every description. It will test any type of motor or dynamo armature.

THE CONSTRUCTOR



How to Make an Electrolytic Rectifier

By C. R. Barmckol

The following are the details for the construction of an electrolytic rectifier for the experimenter who does not want the trouble of dragging numerous large jars about and who does not care to spend much money. If you have a few things around the house the cost is insignificant as compared with the larger rectifiers.

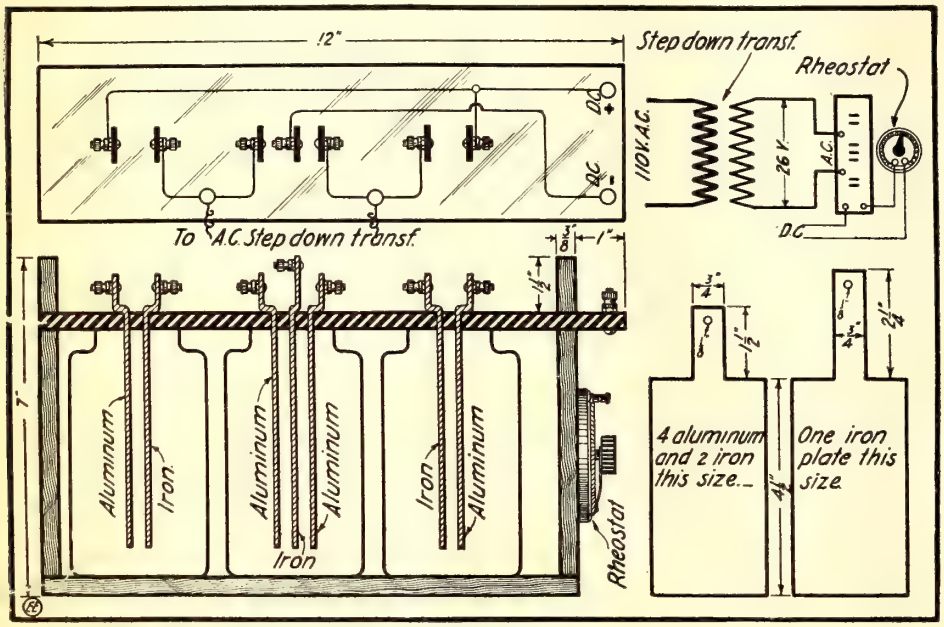
With an alternating current pressure of 26 volts from the secondary of a step-down transformer the rectifier has given as high as 6½ amperes. Of course, it cannot be used for any great length of time owing to its size, but I have recharged storage batteries very successfully by charging at intervals.

The first thing to build is the containing box. The wood should be about ⅜ inch thick, with the following dimensions: 11x7x4¼ inches. A Mellin's Food box will be found very satisfactory. The ends of the box, at the top, are cut down 1½ inches, making U-shaped ends for the top of box. In these slots, where the box has been cut out, the board holding the plates rests. Its dimensions are 12x3½ inches. The containing jars are three ordinary one-pint fruit jars. The next part is the plates. Aluminum and iron are used. The necessary plates are drilled and cut as follows:

Four aluminum plates 4½x2 inches, with lugs 1½x¾, drilled for ⅛ hole, ½ inch from top.

Two iron plates 4½x2 inches, with lugs 1½x¾, drilled for ⅛ hole, ½ inch from top.

One iron plate 4½x2 inches, with lugs 2¼x¾ inches, drilled for ⅛ hole, ½ inch from top.



Parts for Making an Electrolytic Rectifier.

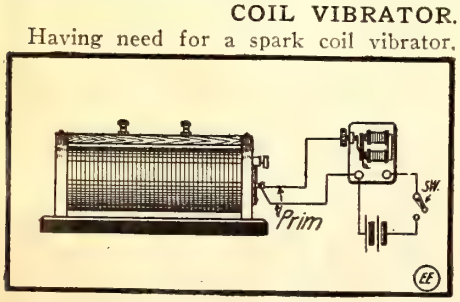
Having procured the plates, they must next be put in place. Their position may be seen in the drawing, the large iron plate being the central plate of the middle jar. The top board is measured off as shown in drawing, the first slot (all slots ⅛x¾ inch) being placed 1¾ inches from edge. One-quarter inch separates this from the next slot, and the drawings give dimensions for the remainder.

Having slotted the board, the plates are then fitted in their position as shown. After fitting them up as tight to the supporting board as is possible, bend the plates over as indicated. This serves to hold them in place. Binding posts from ordinary dry cells can be used, and are placed in the holes drilled in the plates. Having finished this part, mount other binding posts, two for alternating current side and two for direct current side on the board, and connect as shown in drawing. Next mount the rheostat on the end of the box where the cover extends over. It will be seen that by cutting down into the box the lugs of the plates are protected. Next paraffine the inside of the box. The fruit jars are placed in it as shown. The solution is to be made as follows: Fill jars within ¾ inch of top with water. (Warm water is better, but not necessary); then dissolve a heaping teaspoonful of ordinary baking soda into each jar of water. Then to each jar very slowly add about three or four teaspoonfuls of sulphuric acid. Although this solution can be used immediately, it is better to allow it to cool for some time.

The rectifier will be found quite efficient, and its small size makes it very desirable. An ammeter may also be mounted on the side of the box in the case of charging storage batteries. Also another improvement may be added. You may cut a rectangular hole in one side of the box, thus making it an open window rectifier, allowing inspection of the jars without removal. To take out plates and to renew solution only the wire to the rheostat needs to be disconnected. This rectifier utilizes both halves of the cycle.

EMERGENCY SPARK COIL VIBRATOR.

Having need for a spark coil vibrator,



Using Ordinary Buzzer as Spark Coil Interrupter.

and no time to construct one, I hit upon the following idea: Taking an ordinary door-bell and connecting one primary wire to the post grounded to the bell frame and the other to the adjusting screw on the make and break contact, I secured excellent results. The batteries are connected to the bell as usual. Contributed by

JEAN J. EILER.

MAKING A LOW VOLTAGE LAMP.

Procure an ordinary mazda lamp (110, 115 or 120 volt), the vacuum of which has not been impaired. This lamp may have been broken by rough handling or burned out normally. Then connect a socket (which can be placed in any position) to the current supply and screw in the lamp. Tap the lamp so that all or part of the filament comes loose from the wire support. Now shake the lamp around, so that the filament falls across the two lead-in wires. The lamp will light up as soon as contact is made within the lamp.

If the lead-in wires are far apart, the lamp will burn best on 6 volts or more; but if the lead-in wires are very near or the filament extra thick, the lamp will light best on a lower voltage, as 2, 3, 4 or 5 volts.

The writer has had success with about 95 per cent. of all the lamps thus tried. These lamps burn up to 800 hours when filament is new, and from 25 to 200 hours when filament has already been used.

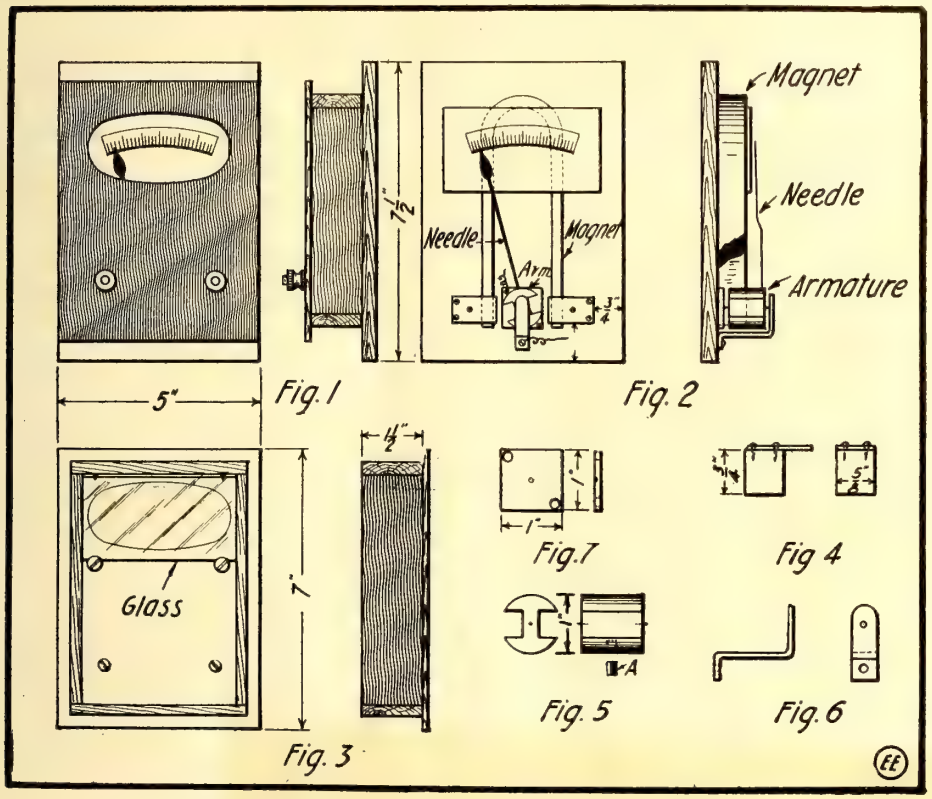
Contributed by EPHRAIM DUSKIS.

Liquid Polish.—*Kieselguhr*, 7 lb.; *Bath Brick* (powdered), 3 lb.; *Oil of Lemon*, 2 oz.; *Lemon Juice*, 1 gal.; *Paraffine Oil*, 1 gal.; *Malt Vinegar*, 4 gal.

A PERMANENT MAGNET TYPE VOLTMETER.

Herewith I suggest how to construct a permanent magnet type voltmeter, which I have made myself and found to work very satisfactorily.

The case (at Fig. 1) is made of any suitable wood that is not too thick. The base of the meter is 5x7½x¼ inches, while the front part of the case is 5x7x⅛ inches, with an egg-shaped hole 3½x2¼ inches



Details and Make-up of Permanent Magnet Style Voltmeter.

cut into it for the glass. The sides of the case are 1½x6x¼ inches. Two holes 2½ inches from the bottom are drilled for binding posts, and a piece of glass is cut and fastened on inside of the case, as shown in Fig. 3, by four tacks. The scale is of cardboard glued to the horseshoe magnet, which is in this case taken from a telephone magneto.

The steel magnet is supported at the top by a strap as shown. This strap is either screwed or glued fast to the base. The side supports are two blocks, with strips of wood tacked or glued on so that they overlap (see Fig. 4). The side supports are fastened to the base in the same manner as the upper block. A wooden block turned into a cylinder, with a groove sawed on each side lengthwise for winding the wire in, constitutes the armature. A portion of a sewing needle is forced into each end, leaving the points projecting to form the shaft of the armature. A hole 3/16 inch in diameter is bored into the bottom of the block, into which a small lead weight A is placed for the purpose of bringing back the armature to normal position after it has swung over, due to an electric charge. Into the top of the armature a straight-pointed aluminum or brass wire 3½ inches long is forced. This serves as the indicating needle.

The front bearing is a piece of strip brass 2¼ inches long, bent as shown in Fig. 6. First ¾ inch is measured off and bent; then it is bent again 1 inch from the first angle, leaving ½ inch for screwing on to the base. A deep center-punch mark is made in the vertical leg of the strip 3/16 inch from the top, which forms the front bearing. The rear bearing, as shown in Fig. 7, is built from a flat piece of a brass door-catch with two perforations bored through it for screws, with a punch mark at the center for the needle point of the armature.

No. 36 wire is wound around the armature, through the slots, after first soldering one end to a needle point. About 150 turns are taken, after which the other end is soldered to the remaining needle. Wires are attached to the screws that hold the bearings and then to the binding posts on the case, after which the case is screwed on by two round-head wood screws. The scale is of pasteboard, glued on to the magnet as shown. If the needle does not move correctly after connecting the instrument to a battery, remove the wires and thus reverse the polarity of the circuit.

To calibrate the instrument, connect it up to one dry cell and indicate where the needle comes to rest by a pencil mark. Then connect it up to two cells; then three, and so on until the needle is at the end of the scale. The first mark signifies 1½ volts; the second 3 volts, and the third 4½ volts, etc. After the marks are numbered the scale can be divided off into fractions of a volt fairly accurately.

Contributed by

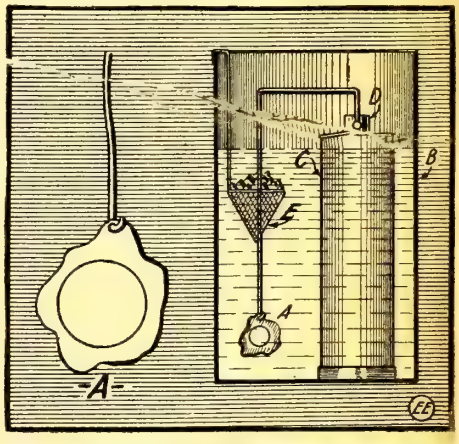
EARLE BELSINGER.

A SIMPLE, YET EFFICIENT ELECTROPLATING APPARATUS.

A novel, interesting, yet inexpensive electroplating outfit may be readily constructed from odd parts, usually to be found in an experimenter's laboratory.

A wide-mouthed jar, of about one (1) quart capacity, will serve for the cell. In this cell is placed a porous cup, which may be taken from an old battery. A rod or strip of zinc is now to be placed in the porous cup and the zinc must be amalgamated by rubbing its surface, previously polished, with dilute sulphuric acid and then with mercury. The mercury will spread over the zinc and give it the aspect of a looking-glass. A piece of wire may be soldered to the zinc (before amalgamating it) in order to attach the mold thereto. In the porous cup is to be placed a solution of dilute sulphuric-acid, made by stirring one (1) part of sulphuric acid in ten (10) of water. The water must not be added to the acid, or the violent reaction might cause an accident with serious result. A saturated solution of copper sulphate, or blue vitrol, is to be placed in the vessel containing the porous cup. The solution must be kept saturated with the copper-salts. This can be done by placing a small basket made of wire screen in the solution and keeping it partly filled with the copper sulphate. The basket must be hung near the top of the vessel in order that the solution may be diffused equally through the water.

The mold is then to be made. Anything that will take the fine lines of an engraving can be used. Gutta-percha and wax are the commonest materials now in use for this purpose. The wax must be warmed and worked into a ball and then pressed over the coin. Gutta-percha must be scalded. The coin should be slightly oiled *before* pressing on the wax, so as to prevent sticking. A small wire must be pressed in on one side of the wax (near the face of the coin) as in top sketch. The mold should be brushed over with powdered black lead (graphite) and polished. Some of the lead must be placed on the wire so as to conduct the electric current. When all is ready fasten the mold to the zinc-rod and place it so it is in the copper-sulphate solution. After leaving it about 12 hours the exact reproduction, or rather impression of the mold will be reproduced in the copper. This can be pried off the wax and the mold used again. The impression may be coated with a thin film of solder on the back by rubbing it over with the soldering fluid, and then by placing a few small pieces of solder on it. A soldering iron should be utilized to melt the solder. In the drawing the various parts of the outfit, designated by letters, are thus explained: A is the mold, B is the containing vessel, C is the porous pot, D is the zinc, and, finally, E is the little wire basket, suspended on wire from the top of the vessel, as clearly shown. When not in use the outfit may be used as an ordinary battery for ringing door-bells, etc. by placing a piece of copper bent in a circle around the porous pot.



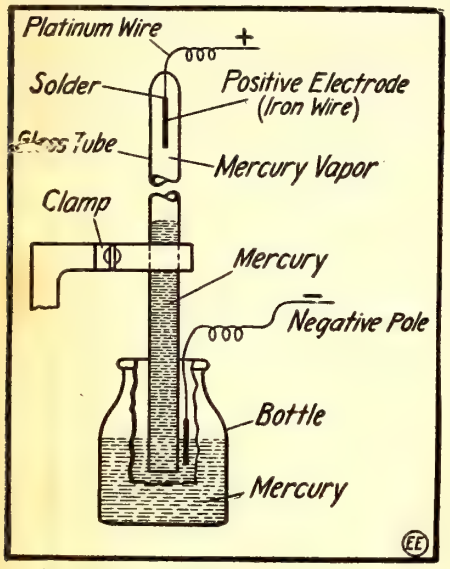
Home-made Electroplating Set.

The most pleasing and satisfactory results and experiments can be carried out if the directions are carefully and exactly followed. Contributed by

WM. WARNECKE, JR.

A HOME-MADE MERCURY VAPOR LAMP.

A mercury vapor lamp may be easily constructed by any experimenter with the aid of a very simple apparatus, by making use of the principle of a Torricellian, or barometer vacuum. The above vacuum is produced when a long tube is closed at one end, completely filled with a liquid and then inverted with its open end under the surface of more of the same liquid, as the illustration shows. Under these conditions the liquid, if the tube be long enough, will fall to a certain height above the lower liquid level. The space above the liquid is left empty, except for the small amount of liquid which evaporates into it, existing as vapor.



Home-made Mercury Vapor Lamp.

Mercury vapor lamps consist essentially of a positive electrode of iron and a negative electrode of mercury, projecting into a vacuum saturated with mercury vapor. Minor details as to the means of starting may be omitted here for the sake of brevity. This vapor, under certain conditions, is capable of carrying a current of electricity, at the same time becoming heated and producing a dazzling, bluish-white light.

The mercury vapor lamp is made as follows:

Procure a glass tube about 40 inches long, of about ¼-inch bore, with medium thick walls and open at both ends. By heating very carefully and gradually, first in the smoky flame and then in the bluish flame of a gas or alcohol torch, the walls become softened, so that they will close together around a piece of platinum wire twisted to a piece of No. 12 iron wire, thus sealing it into the tube.

Fill the tube thus prepared with some pure mercury, which has been boiled to remove all of the inclosed and dissolved air. This boiling should take place in a glass or porcelain vessel. The resulting fumes, which are *very* poisonous, should not be inhaled.

The glass tube must be wholly and completely filled with mercury. Not even a bubble of air should be left behind, sticking to the walls; otherwise the operation will be a decided failure. When absolutely sure that all the air has been removed, close the open end of the tube with the thumb, and by inverting it place this end under the surface of some mercury in an open vessel. Then, *while still under the surface,* remove the thumb.

This done, the column of mercury will not completely fill the tube, but will fall to a height of about 29 inches. In falling from the top of the tube, since there was no air present, it might be supposed that there would be a space quite empty left above the mercury. This is very nearly, but not exactly, true, as the mercury, like water, only to a much smaller extent, will evaporate, thus filling the space above it with attenuated mercury vapor.

Clamp the tube in a vertical position and attach one terminal to the mercury in the dish by merely inserting a wire in it and the other to the iron wire electrode terminal projecting from the top. The current used may be 110 volts direct current, taken from the street mains, or from any other convenient source.

When the power is first thrown on, no current will flow because of the very high resistance of the space between the electrodes. If a spark from an inch or even ½-inch spark coil be sent across the terminals, it will break down this high resistance and pass. In doing so it will cause the formation of much more mercury vapor than before, on account of the resulting heat. The path of this spark will then have much less resistance than the space had before, on account of the greatly increased amount of vapor present. Because of this lowered resistance the main current is now able to pass, and in doing so will heat the vapor in its path to a bluish-white, dazzling light, with which the reader is familiar. Contributed by

ALFRED MORGENBOLD.

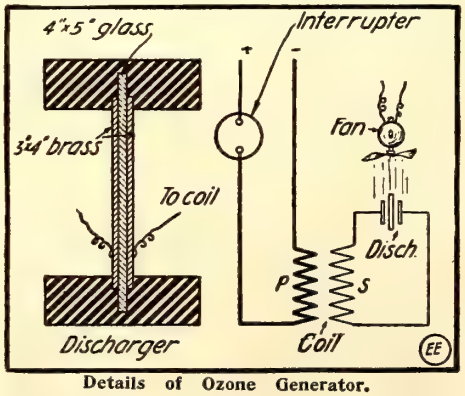
HOW TO BUILD AN OZONE GENERATOR.

The peculiar properties of ozone as a purifier and sterilizer have made it very serviceable for use in libraries, homes, factories, etc. An apparatus to produce ozone, termed Ozonator, can be readily made and advantageously employed.

This generator should be made up of three distinct parts—the high-tension induction coil, such as a two-inch spark coil; the discharging device and the circulating fan. These are treated in the following paragraphs.

An ordinary spark coil, having heavy contact points, in order to stand continuous work, and better still, if used on 110-volt alternating current, with its vibrator closed and in series with a suitable resistance, should be employed. If direct current is available an electrolytic interrupter should be placed in a vessel containing some water, or, still better, circulating water, so as to cool the solution of the interrupter. This latter method of running the coil will be found very satisfactory. It should be connected in the usual way.

The discharging device is next to be considered. To ozonize air it is essential that a visible electrical corona or brush discharge be produced. This takes the form of a violet glow and is always the index of an extremely high potential or voltage.



Details of Ozone Generator.

There have been many forms of dischargers developed, among which the one herein treated is quite efficient and, moreover, simple in construction.

Two pieces of heavy sheet brass, measuring 3x4 inches, are placed in a horizontal position, one-eighth inch apart, in grooves in a fiber base. Rubber should not be used, as it carbonizes quickly under such electric stresses as it would be subjected to, and wood has too low a dielectric strength. Between the brass pieces in another groove, at least one-quarter of an inch deep, should be fitted a one-eighth-inch sheet of plate glass, measuring 4x5 inches. The difference in potential of the two electrodes, which are connected to the secondary terminals of the coil, is sufficient to cause a violet "brush" or corona discharge to form in the spaces between them and the dielectric. In these spaces enough ozonized air is produced in a short while to purify and freshen the air in a comparatively large room or hall.

The function of renewing the air between the electrodes and forcing the ozonized product out into the room is performed by a small electric fan, operated either by storage batteries or on a lighting circuit. It should be placed several inches behind the discharger, so that the air flows through the electrodes and out into the room.

The complete ozone generator may be mounted or cased, as the builder desires. The different parts are connected in the manner shown in diagram.

Contributed by

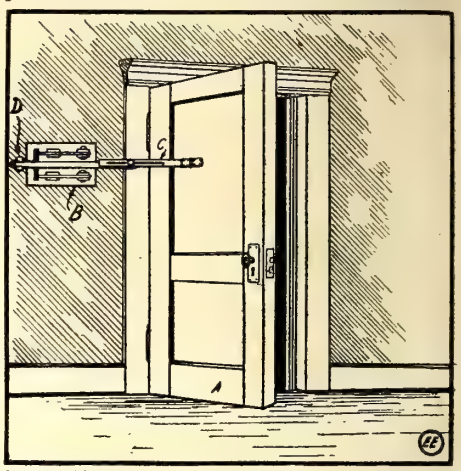
WILLIAM AMPERE.

[Ed.—It is usual to employ a small 75 to 100 watt alternating current step-up closed core transformer for this purpose. One giving about 7,000 volts at the secondary is used in several commercial ozonators of small type.]

AUTOMATIC LIGHTING SWITCH.

How many times have you entered a dark room with your hands full and found to your great perturbance that to turn the light on you would have to drop everything, thus losing time and also patience? To alleviate this, the following may aid you to lose less of your patience and also to retain your good nature:

Remove the switch and place it in such a position that it will be behind the door when opened. Then procure a piece of wood (use your own judgment in selecting); also another piece about 4 inches by ¾ inch, and join these pieces as shown in diagram, nailing crosspiece to door. Now bore a hole through the handle of the switch and also in the stick nailed to the crosspiece. Put an axel from an old skate wheel through the holes and fasten them by an ordinary machine pin. Now the opening and closing of the door will turn the switch automatically on and off.



Switch Fastened to Door by Rod "C" Cuts Off Lights Automatically.

Contributed by

ANDREW M. GALLAGHER.

HOW TO MAKE IT

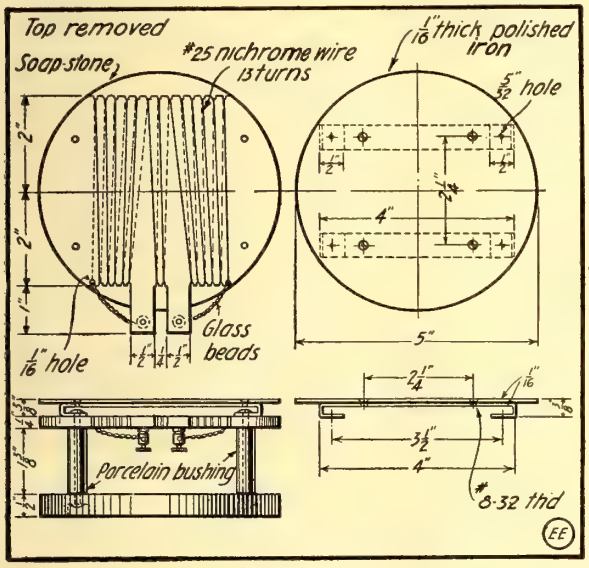


This department will award the following monthly prizes: FIRST PRIZE, $3.00; SECOND PRIZE, $2.00; THIRD PRIZE, $1.00.
The idea of this department is to accomplish new things with old apparatus or old material, and for the most useful, practical and original idea submitted to the Editors of this department, a monthly series of prizes will be awarded. For the best ideas submitted a prize of $3.00 will be given; for the second best idea a $2.00 prize, and for the third best a prize of $1.00. The article need not be very elaborate, and rough sketches are sufficient. We will make the mechanical drawings.

FIRST PRIZE $3.00.

A USEFUL 495 WATT ELECTRIC STOVE.

The enclosed drawing shows a simple way of making an excellent electric stove for use on a circuit of 110 volts at 4.5 amperes. This stove will be interesting for those who like simple designs.



Practical and Useful Home-made Electric Stove.

The heating element is made from asbestos or soapstone; either one will do, as it is easily cut with a hack saw. Then it is wound with No. 25 Nichrome wire (9½ feet in all). After it is wound a few beads are slipped on the ends, so as to insulate them from outside objects, and fastened by means of binding posts.

The unit is supported by four screws running through porcelain bushings and fastened to a slate base. When this is done a cover is cut from 1/16-inch thick iron and fastened to the screws. This will be useful for heating the coffee pot, etc.

Contributed by FRANK HARAZIM.

AN ACID-PROOF CEMENT.

A very good acid-proof cement for cementing articles exposed to acids may be made up of a mixture of litharge (yellow lead) and glycerine. Mix to a stiff paste and use quickly, as this cement sets quite rapidly.

A Good Varnish for Electrical Apparatus.

A very good insulating varnish for metal work on electrical instruments is black asphaltum varnish. It has a finish like black enamel and good insulating qualities.

If this finish to too glossy a varnish made from orange shellac and lampblack should be satisfactory.

This latter is better for woodwork, while the first is better for metal work. Contributed by WALTER FRANSEEN.

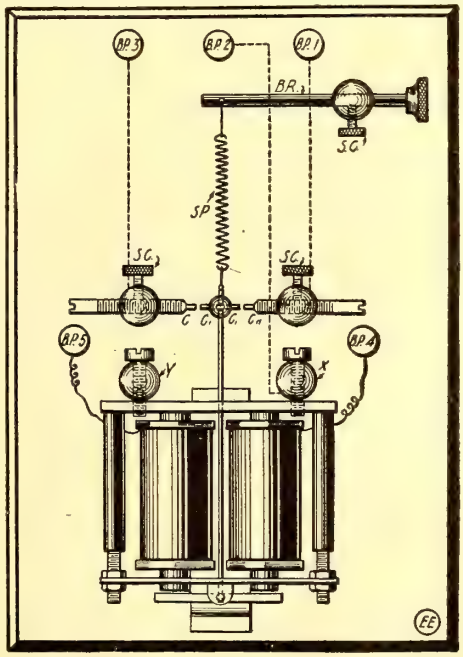
SECOND PRIZE $2.00.

A SIMPLY CONSTRUCTED POLARIZED RELAY.

Many experimenters have found it impossible to use a polarized relay owing to the prohibitive price which is usually charged for this instrument. The following description, together with the accompanying drawing, will enable one to make a simple yet efficient instrument of this character with little trouble:

An alternating current or magneto bell ringer (polarized type) is mounted on a wooden base about 4x8 inches. A hole is drilled through the clapper ball to accommodate a pair of silver or platinum contacts C′ and C′ as shown. Adjustable contact screws C and C″ are mounted so as to be engaged by the contacts in the clapper. A spring SP connects the clapper with a rotatable and slidable rod BR, which serves to hold the contacts C′ and C′ in a neutral position between the contacts C and C″.

Connections are made as shown by heavy dotted line. Upon the reception of a direct current either one or the other of the circuits will be closed, depending upon the direction of the current. By the use of this instrument either of two circuits may be closed at will over a two-wire line by means of a key and a simple pole-changing switch. Contributed by HENRY B. GRAVES, JR.

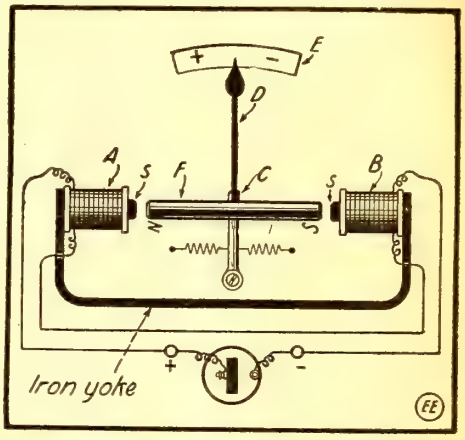


Polarized Relay Constructed from A. C. Telephone Bell.

THIRD PRIZE $1.00.

A MAGNETIC POLARITY INDICATOR.

Magnetic polarity indicators are not very well known to the average experimenter, and the sketch herewith shows a plan for making up one from a pair of 20-ohm electro-magnets and a small permanent steel magnet, properly mounted. While one electro-magnet can be used in making up this device as at A, it is best to use two of them as sketch shows. The small permanent magnet, which can be made of a piece of magnetized tool steel about 1 inch long by ¼ by 1/16 inch, is mounted on a pivoted arm C carrying an indicating needle D. A paper scale is mounted suitably on the device, as at E, with a zero center mark. Care must be taken in hooking up the electro-magnets, so that when the positive pole of the circuit is joined to the binding post marked "plus" the proper magnetic poles will be produced in the electro-magnets to give the maximum effect or reaction on the permanent magnet F. This can easily be ascertained by making a couple of tests with different connections from the magnet coils. When two magnet coils are used, mounted on a soft iron yoke (made of ½x⅛-inch stock) the two core ends facing each other will have to produce the same magnetic poles, so that in one air gap the magnetic action between the permanent magnet and the coil A will be "attractive," while in the opposite air gap, at magnet B, the magnetic effect will be "repulsive." This acts on the principle that like poles *repel*, while unlike poles *attract* each other. Contributed by G. BARENBLATT.

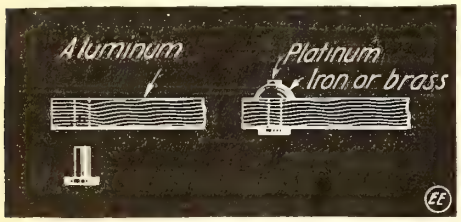


Magnetic Type Polarity Indicator.

A dime in time may save nine. A single idea gleaned from these columns may save you money and time going over ground already covered.

FASTENING CONTACT POINTS ONTO ALUMINUM.

Sometimes it is convenient to use aluminum as the moving element on an instrument such as a moving coil relay, or in wireless telegraphy when the element must necessarily have a small time period to prevent lag. These moving elements must have contact points on them, and as it is difficult to solder them onto aluminum I hereby propose a plan which has proven successful.



Method of Securing Platinum Point to Aluminum Parts.

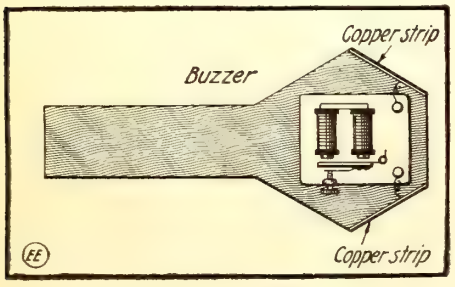
A small rivet, made necessarily of light material, such as from lath or shingle nails, can be riveted to the aluminum. Sheet platinum can then be soldered to the nail head, which first must be well cleaned and scraped. This will present a comparatively large and non-oxidizing surface to the spark. By referring to the illustration this will be made very clear. Contributed by R. E. RYBERG.

A HANDY DRY CELL TESTER.

Practically the simplest and most commonly used method in vogue for testing the electrical activity of dry cells is that involving the use of an ordinary buzzer or bell. If any number of cells worth mentioning are to be tested it is rather a tedious job to try out each with two wire terminals from a buzzer. Therefore I provide in this suggestion a very quick and efficient method of testing such batteries, and the sketch makes this idea quite clear.

It consists simply of a piece of wood cut to the shape indicated; on the lower part of it is mounted a small buzzer. The two terminals of the buzzer connect by pieces of copper wire to two copper strips, as shown. All that is necessary is to place the lower part of this wood support between the binding post of the dry cell so that the two copper shoes on same make contact with the zinc and carbon binding posts.

Contributed by MONROE MILAM.



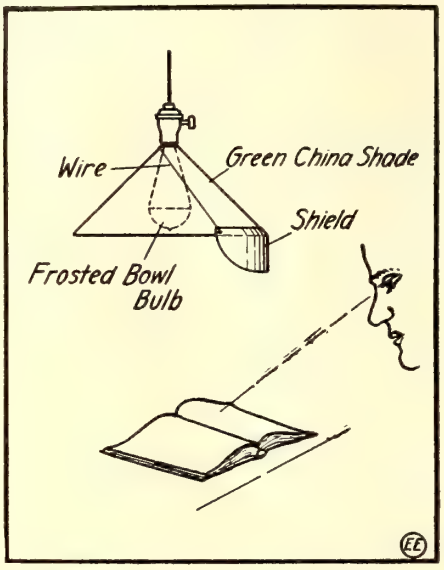
Testing Device for Battery Cells.

A GOOD READING LIGHT.

Have you a good reading light? If this very important question was put to a mass of people 99 per cent. of that mass would be compelled to answer in the negative. Why?

The reason that good lights are so uncommon is not so easy to discover. Perhaps the best explanation may be found in the well-known proclivity of the human mind to accept without question the things it is most familiar with, and to turn to the unfamiliar and remote in its efforts at improvement. It is only within recent periods that it has been made possible for most every individual to be provided with an artificial light that is practically as good as daylight.

If electric light is used in a dome over the library table the dome should be arranged to take a single Mazda or tungsten lamp, which should be fitted with a prismatic or opal glass reflector, and the lamp itself should be what is called "bowl-frosted," i. e., have the lower part of the lamp frosted. A 60-watt tungsten lamp will give ample light under all ordinary conditions and will use very little more current than a single 16 C. P. carbon filament bulb, which consumes about 54 watts. Desk lights should be fitted with a reflecting, or rather deflecting, shade, to prevent the direct or

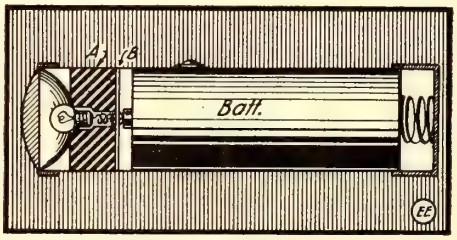


Efficient Desk Lighting Scheme.

even strongly reflected light rays from striking the eye. A sufficient, yet soft, light is that which proves the least trying to the eye. Indirect lighting is widely employed, but is not universally adaptable to all requirements.

A FLASHLIGHT "BULB" PROTECTOR.

Those who are troubled with the cracking or breaking of flashlight bulbs and filaments will find the following device an antidote for these unpleasant mishaps:



Lamp Protection for Flash-Lights.

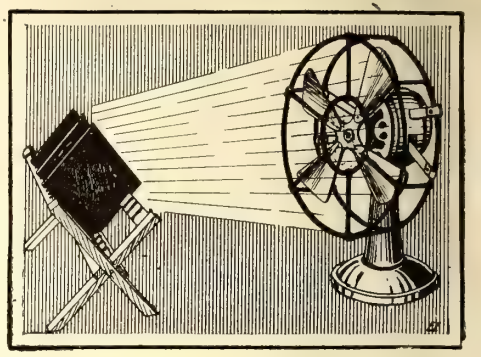
All that is necessary is a block of either fiber, hard rubber or wood, backed by a copper disc. Through the center of this block is bored a hole, large enough at one end to allow the base of the lamp to fit in with ease. Just below the disc of copper the hole is made smaller, with a small spring attached.

The object is to take the weight of the battery off the lamp bulb and put it on the case instead.

Contributed by WATSON McALEXANDER.

ELECTRIC FAN HELPS DRY PHOTO NEGATIVES.

Those engaged in developing and drying photographic negatives will find an ordinary electric desk fan of great value in quickly drying such negatives as they rest in their drying rack. The fan is placed a few feet



Electric Fan Quickly Dries Photo Negatives.

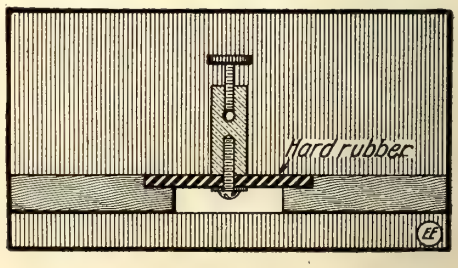
away from the negatives, and it is best that this arrangement is so located that a good draught of fresh air can be drawn in through the fan from an open window. The negatives will be dried very quickly in this way, and it is considered by many photographers as much superior to the use of artificial cooling baths.

ETCHING ON STEEL.

Cover the article with a film of paraffin wax (or candle grease) and with a scriber write or mark on the surface whatever is required, making sure to cut clean through the wax. Sprinkle some salt over this and then cover with strong nitric acid. The etching should be continued for an hour or so, depending upon the depth of the etched part. Then clean off with hot water and grease the article to prevent any rusting.

Rust Preventive.—The following is a good rust preventive for steel: 16 parts *Turpentine* and 1 part *Caoutchouc* dissolved by a gentle heat. To this add 8 parts *Boiled Oil,* stir and at the same time bring to the boiling point. Apply with a brush after the manner of varnishing. This coating can be removed by the use of *Turpentine* if desired.

IMPROVED BINDING POST MOUNTING.



Improved Insulation for Binding Posts.

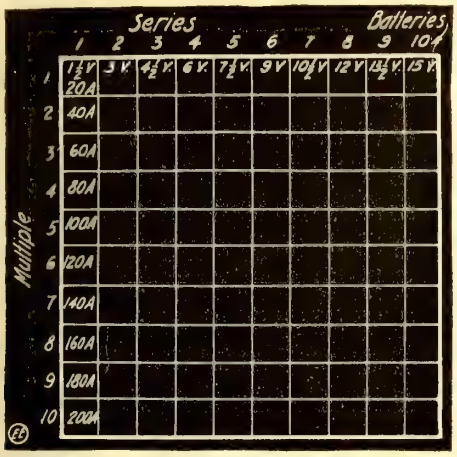
The sketch herewith shows a method of using ⅛ inch hard rubber (or other thickness) as an insert in table or cabinet tops to support binding posts, spark-gaps, helix stands or other connections which carry high potential or high frequency currents.

This results in better insulation and greater efficiency without the excessive cost of using hard rubber for the entire surface. It is recommended for wireless receiving sets also if maximum efficiency is to be realized from such sets.

Contributed by I. L. JONES.

A BATTERY COMPUTING TABLE.

A convenient table to have at hand for quickly calculating the power of dry cells connected up in various ways is shown in the accompanying illustration. This table



Direct Reading Battery Chart.

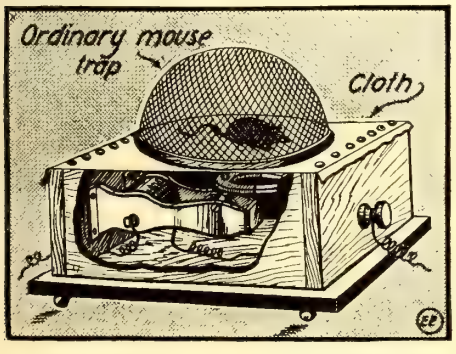
is worked out for "new" dry cells only. Each square represents a single dry cell. Should a battery with an output of, say, 6 volts, 60 amperes be desired, then 6 volts are depicted on the top line under the (cell) number 4, signifying that it takes four cells in series to produce 6 volts. Sixty amperes will be found on the side row opposite the figure 3, indicating that three cells in multiple make 60 amperes. Now four cells in series and three rows in multiple ($4 \times 3 = 12$) give 12 cells necessary for the desired output. Also, as each of the 12 squares represents 12 cells, the arrangement can be readily understood.

Any combination up to 15 volts, 200 amperes may be obtained. Contributed by

ARTHUR R. DARLING.

A MYSTERIOUS MOUSE WINDOW ATTRACTION.

On the end of the motor shaft, as depicted, a horse-shoe magnet of tungsten steel is attached. This, of course, must be well magnetized. An old, weak one, will not do. Now, on top of the wood box, where the cover was removed, a cloth is fastened, by small tacks, as shown in sketch. Two binding posts may be placed on the side of box, as will be noted. Next a mouse-trap (of circular shape, preferably) is obtained and the entire base thereof removed so as to leave the hollow, wire net only. A little gray mouse (costing but a few cents) of plaster-paris is needed,



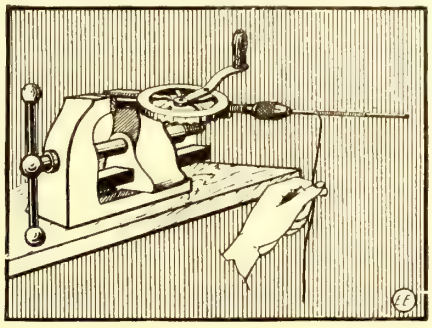
Magnetic Revolving Mouse Window Display.

such as are usually sold in stationery stores, also a piece of iron ½ inch thick is tacked to the bottom of the mouse. The base, however, so as not to be noticed, must be neatly trimmed off so as to fit the lines of the little creature. When all is ready the mouse is placed on the cloth, the wire net placed over the mouse, and the motor set rotating. As the motor turns around the mouse will also hurry around, being attracted by the magnetism of the horse-shoe magnet on the revolving shaft of the motor. It is desirable that the motor should not run too fast. Contributed by

WM. WOODHOUSE, JR.

WINDING RESISTANCE COILS.

Many an experimenter has wanted to make a resistance or perhaps an electric toaster or heater but was at a loss as to



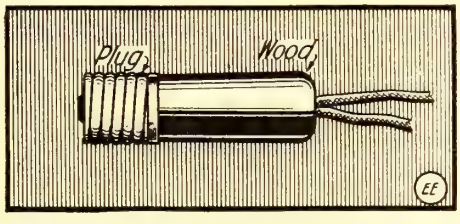
Hand-Drill Used for Rapid Winding of Resistance Coils.

winding the coils of the resistance wire. While making a resistance I hit upon the following method of winding the coils: The handle was removed from a hand drill and the drill fastened in a vise so that the crank could revolve freely. A ⅜-inch rod, 5 inches long and with a ⅛-inch hole in one end, was fastened in the chuck. The wire for winding the coils was No. 22 iron (German silver would do), having been obtained from a basket factory. The wire was cut into as many 9 foot lengths as coils were needed. The end of the wire was put through the hole in the end of the rod and the wire wound on the rod in one closely formed layer. The end of the wire is pulled out of the hole and the coil slipped off the rod. This gives a coil about 4 inches long, but when stretched to about 6 inches in length the adjacent turns do not touch. I wound 120 of these coils in one afternoon, using this method. Contributed by

ALBERT P. VANSELOW.

A CHEAP ATTACHMENT PLUG.

Herewith I suggest a method for utilizing



Attachment Plug Made From Wooden Rod and Lamp Base.

to good advantage an old incandescent lamp base and a piece of broomstick.

Empty the lamp base of everything except two wires, which should be threaded through a hole bored in the center of a short stick cut from an old broom handle. The wires are then soldered firmly to a couple of flexible leads. The wooden plug may be cut down until it just fits into the brass cup and with a little glue it can be made to hold fast.

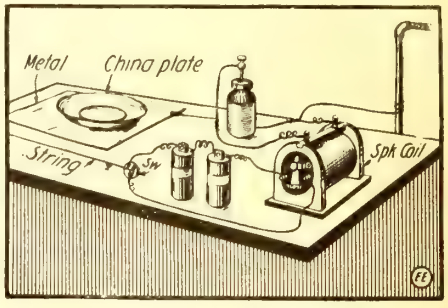
This completes a neat, yet very cheap and effective attachment plug for laboratory requirements. Contributed by

LAWRENCE MICHELS.

AN ELECTRIC "HOUND" CHASER.

For those who are troubled with neighboring dogs (hounds and such), the following scheme will be found efficacious in getting rid of them thoroughly and finally.

All that is required is a small spark coil which most experimenters have about their laboratory, together with a Leyden jar, a



Electric Shocker for Dogs.

china plate and a piece of string with batteries and a switch for same.

The piece of string is arranged near the china plate containing milk or meat, so that when his "Riverence the Pup" strides toward the plate his foot engages the string which closes the battery switch and a metal plate or sheet under the china plate is then charged with high voltage from the spark coil.

Needless to say, this makes the most *highly seasoned* dish that friend "Pup" ever dined on. Contributed by

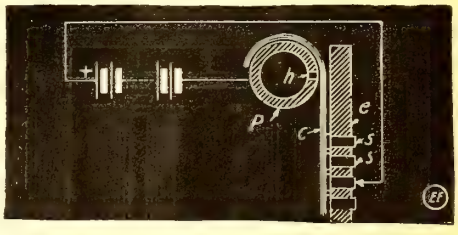
C. L. ROBINSON.

A VISUAL PHOTOTELEGRAPHIC RECEIVER.

A visual receiver for phototelegraphy and telectroscopy, employing a special electrolyte, has been recently invented, says L. H. Walter, in the *Proceedings of the Royal Society*. The schematic sketch is herewith shown.

It consists of luminous elements, 5,500 in number, with independent electrical connections placed in a frame, which is hardly larger than that of an ordinary camera. The anodes *s* are embedded in an ebonite plate *e*, their backs being wetted by an electrolyte which escapes from the holes *h* of the pipe *p* and flows over the crape *c*. A voltage of 130 to 140 volts is used. The negative pole of the circuit is connected to the pipe *p*, while the anodes *s*, which are to be rendered luminous, are connected to the positive pole.

This arrangement can be used for various applications, as it combines in a lim-



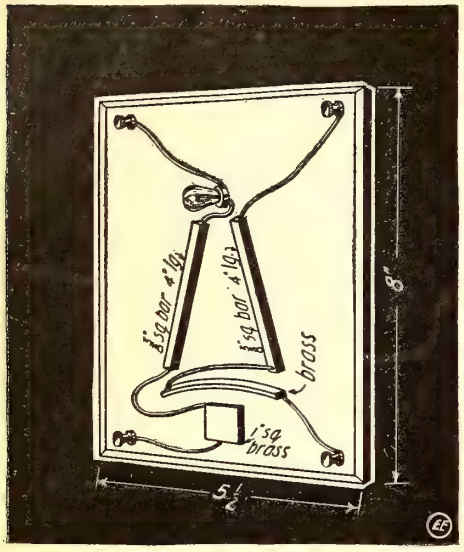
Visual Phototelegraphic Receiver.

ited space almost an unlimited number of elements, the surface of which can be illumined or darkened hundreds of times a second at will. The degree of luminosity can be adjusted by the voltage applied.

Wireless communication between Scandinavia and America, with an intermediate station in southern Greenland, has been proposed.

A HANDY FUSE TESTER.

Many electrical experimenters have cartridge fuses on most of their instruments. The following diagram will show a good



Quick Test Board for Fuses and Lamps.

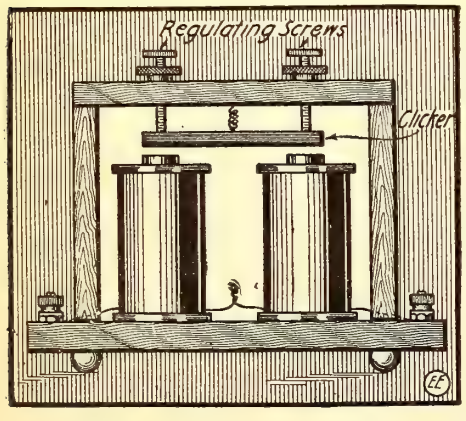
way to test them. This apparatus can be used to test fuses of any kind by making the block of wood to fit the length of the fuse. Contributed by

CARL MENKE.

A NOVELTY AMONG TELEGRAPH SOUNDERS.

A novel telegraph sounder of quite odd proportions is described and depicted in the following contribution:

First two wood posts are mounted in an upright position on a base of wood, neatly varnished. Then another wood rod is fastened on the upright ones at each end, as will be seen in the sketch. In other words, it is bridged across, from one to the other, as drawing depicts. A pair of electro-magnets are mounted on the bottom of the wood base, as perceived. Two binding posts are fastened to the base of the apparatus, and, of course, put in circuit with the magnets. For clicker an iron shaft, such as door-knobs are fastened on, offers itself well for this purpose. A small spring to make tension is soldered to the steel shaft, and the other end (of spring) is tacked to the top wood piece, which is shown in sketch clearer than words can



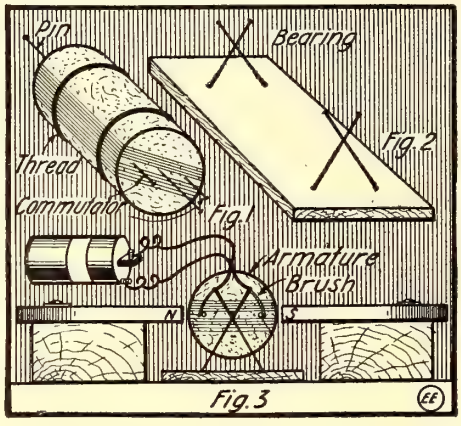
Unique Style of Telegraph Sounder.

describe it. After the regulation-screws (at the top) are properly adjusted, the instrument is ready for use. It may be put in circuit with a telegraph key, as usual.

Contributed by WM. WARNECKE, JR.

MAKING A MOTOR IN 10 MINUTES.

Anyone having some wire, a few pins and a cork can construct this motor in less than 10 minutes. The armature consists of a cork having a pin stuck in each end. See that the pins are exactly in the center or the armature will wobble. Wind the armature with No. 30 enameled wire, as shown in Fig. 1. Stick four pins in a piece of wood as at Fig. 2. Arrange the armature, bearings, brushes and magnets, as in Fig. 3. The brushes are of No. 26 wire, bent as per sketch. Although simple, this motor will run very swiftly with one



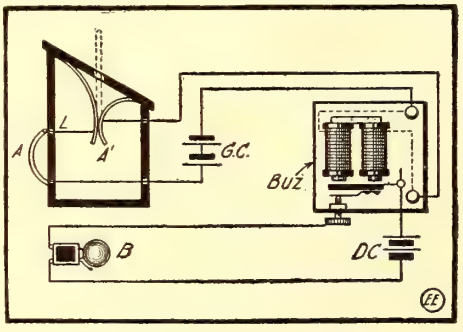
Simple Motor Made From Cork and a Few Pins.

dry cell. It also demonstrates the principle of large motors very clearly and at the lowest possible expense. Contributed by

MATT JAROSZ.

CLOSED CIRCUIT MAIL BOX ALARM.

Herewith is presented a very serviceable mail box alarm of the closed circuit type.



Closed Circuit Alarm for Mail Boxes.

A′ is made of two light pieces of some flexible metal, and is bent, as shown, to separate when a letter is dropped in the box. A is of the same material, but much heavier, and is so constructed that when a parcel or letter is placed in contact A′ is opened from L. The springs should be connected in series with each other, and a pair of "crowfoot" gravity cells is then connected to a buzzer with the windings arranged as illustrated. A bell and two dry cells are connected to the vibrator contact and to the iron armature bar of the buzzer.

When the closed circuit is broken the armature of the buzzer rebounds and closes the local bell circuit, thereby sounding the alarm and signifying that a letter or parcel is in the box. Contributed by

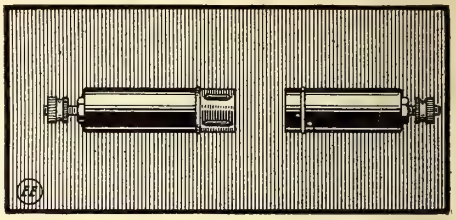
S. F. CSOHAR.

A SIMPLE CONNECTOR FROM PENHOLDERS.

One glance at this neat little device is sufficient to disclose its simplicity, usefulness and niftiness. It is constructed from a simple metal penpoint case (for holding penpoints, and which usually come with Eberhard Faber's pencil sets). Two holes are drilled in on both ends of the case and posts from old batteries are fastened therein.

This is all that is necessary, and the sketch plainly shows how the device is operated to make a connection.

It is invaluable for running small motors,



Electric Connector Utilizing Pencil Tips.

lighting automobile lamps and miniature lighting systems, etc. It is merely clipped together, the action being the same as if a penpoint were taken out and the case closed again. Contributed by

ALGERNON W. WRANDON.

SOLDERING IRREGULAR PIECES.

To solder accurately irregular pieces of metal or the parts of a broken piece, press the parts into a lump of putty, placed on a piece of tinplate. Having thus formed a mould, remove and dry the putty with a gas jet. This burns the oil in the putty. When the mould is ready replace the pieces and also some solder in small pieces. Use a gas jet or blow-torch to heat same and do not remove the parts until quite cool.

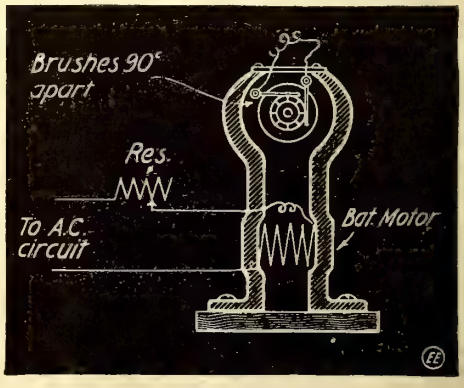
BATTERY MOTOR ON ALTERNATING CURRENT.

Many experimenters have some small battery motors which they wish to run on alternating current. For this purpose the following directions will be found efficacious:

The field windings should be connected in series with a suitable high resistance. The brushes are short-circuited and then adjusted to give the greatest speed and power. It has been found that a 6-volt, 4-ampere "Knapp" motor will operate best when the lower brush is at right angles with the upper one. No connection whatever is made between the field and armature. Contributed by

PERCY M. ROOPE.

[Ed.—*This is the "repulsion type" of alternating current motor principle. For best results the iron frame should be laminated or made up of many soft iron sheets, firmly bolted or clamped together.*]



Operating Battery Motor on A. C. Circuit.

A year's subscription would make an appropriate Xmas gift to your friend.



Under this heading we will publish every month useful information in Mechanics, Electricity and Chemistry. We shall be pleased, of course, to have our readers send us any recipes, formulas, wrinkles, new ideas, etc., useful to the experimenter, which will be duly paid for, upon publication, if acceptable.

FORMULA No. 16.
Soaps.

Transparent Soap.—Slice 6 lbs. nice *Yellow Bar Soap* into shavings; put into a brass, tin or copper kettle, with *Alcohol*, ½ gal., heating gradually over a slow fire, stirring till all is dissolved; then add 1 oz. *Sassafras Essence* and stir until all is mixed; now pour into pans about 1½ inches deep, and when cold cut into square bars the length or width of the pan, as desired.

English Bar Soap.—Six gal. *Soft Water*, 6 lb. good *Stone Lime*, 20 lb. *Sal-Soda*, 4 oz. *Borax*, 15 lb *Fat* (*Tallow* is best), 10 lb. *Pulverized Resin* and 4 oz. *Beeswax;* put the water in a kettle on the fire, and when nearly boiling add the lime and soda; when these are dissolved, add the borax. Boil gently and stir until all is dissolved; then add the fat, resin and beeswax.

Best Soft Soap.—Mix 10 lb. *Potash* in 10 gal. *Warm Soft Water* over night; in the morning boil it, adding 6 lb. *Grease;* then put all in a barrel, adding 15 gal. *Soft Water.*

German Yellow Soap.—Tallow and *Sal-Soda*, of each 112 lb.; *Resin*, 56 lb.; *Stone Lime*, 28 lb.; *Palm Oil*, 8 oz.; *Soft Water*, 28 gal. Put soda, lime and water into a kettle and boil, stirring well; then let it settle, and pour off the lye. In another kettle melt the tallow, resin and palm oil; having it hot, the lye being also boiling hot, mix all together, stirring well, and the work is done. *For small quantities—Tallow* and *Sal-Soda*, each 1 lb.; *Resin*, 7 oz.; *Stone Lime*, 4 oz.; *Palm Oil*, 1 oz.; *Soft Water*, 1 qt.

Hard Soap with Lard.—Sal-Soda and *Lard*, each 6 lb.; *Stone Lime*, 3 lb.; *Soft Water*, 4 gal.; dissolve the lime and soda in the water by boiling, stirring, settling and pouring off; then return to the kettle (brass or copper) and add the lard, and boil it till it becomes soap; then pour into a dish or moulds; and, when cold, cut into bars and dry it.

Camphor Soap.—Curd Soap, 28 lb.; *Otto of Rosemary*, 1¼ lb. Reduce the *Camphor* to powder, add 1 oz. *Almond Oil*, then sift it; when the soap is melted and ready to turn out, add the camphor and rosemary.

Sand Soap.—Curd Soap, 7 lb.; *Marine Soap*, 7 lb.; *Sifted Silver Sand*, 28 lb.; *Oils Thyme, Cassia, Caraway* and *French Lavender*, of each 2 oz.

Shaving Paste.—4 oz. of *Naples Soap*, 2 oz. of *Powdered Castile Soap*, 1 oz. of *Honey*, 5 drops each of *Essencce of Ambergris, Oil of Cassia, Oil of Nutmegs.* Melt the soap in water bath, add honey and when nearly cool add the oils and essence.

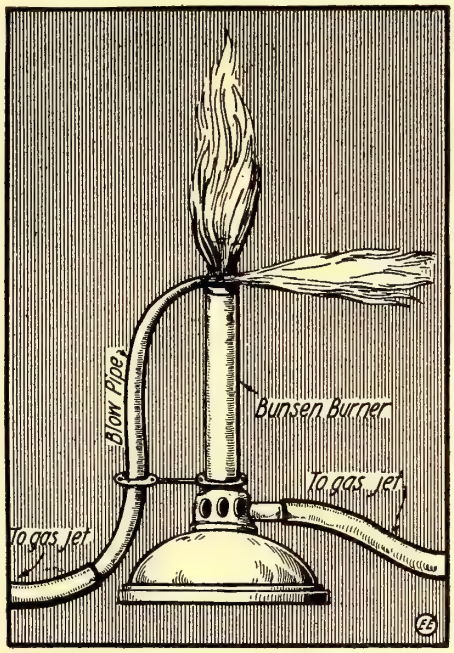
"SOLDER" FOR METAL, GLASS AND PORCELAIN.

A soft alloy which adheres to metal, glass and porcelain and can be used in the same manner as soft solder is prepared from powdered copper (copper dust) which may be obtained by stirring a solution of blue vitriol with granulated tin. The solution becomes considerably heated and a fine brown powder is precipitated. Of this copper dust, 20 or 36 parts by weight, according to the desired hardness of the solder, are mixed in a cast-iron or a porcelain mortar with sulphuric acid of 1.85 specific gravity to the consistency of paste, and 70 parts of mercury added with constant stirring.

When the amalgam is thoroughly mixed it is carefully washed with water to remove all traces of acid, and then cooled off. In 10 or 12 hours the mass becomes very hard. When the solder is to be used it should be heated to about 400 degrees Fahrenheit, in which condition it can be kneaded like wax in an iron mortar. In this plastic state it is applied to the broken surfaces, which are then pressed together, and when cooled the amalgam adheres very firmly. Contributed by DAVID KARRON.

A DOUBLE FLAME LABORATORY BLOW TORCH.

While working in a laboratory last winter I frequently needed a blow torch for welding purposes, but as there was none in the laboratory equipment I struck upon a novel means of making the desired heat. I attached a mouth blow pipe to a gas jet



A Double Flame Laboratory Blow Torch.

by means of a rubber tube and, turning on the gas, held the blow pipe in the flame of a Bunsen burner. The gas coming through the blow pipe had the desired effect upon the Bunsen flame, producing as great or greater heat than the average blow torch.

Contributed by HARRY R. FEES.

Shabby leather can be much improved by either *Linseed Oil* or the well-beaten *Whites of Eggs* mixed with suitable coloring matter. The surface can be brought to a gloss by the use of a soft duster.

To Clean Brass.—Rub it with a mixture of *Vinegar* and *Salt*, or *Oxalic Acid*, then wash with *Water* and polish with *Tripoli* and *Sweet Oil.*

SOME USEFUL WRINKLES FOR THE EXPERIMENTER.

Turpentine makes a very good lubricant for a drill when boring thin glass.

A liberal coating of parrafine on the outside of battery jars keeps the acid from climbing.

It is hopeless to try to restore dry cells to their former strength, but after they have lost most of their voltage they can be partially restored by soaking them in a solution of salt water and drilling a number of holes around the base of the battery to let the solution soak in.

A very good way to intensify weak radio or telephone signals when using only a single pole watch case receiver is to procure a large magnet from some electrical supply store. Bind one of the poles on the back of the receiver where the screw that holds the bobbin protrudes (some little experimentation will have to be done to determine the right pole), and the signals will be found to have been increased to three and four times their previous strength.

Never try to tap your local telephone line. The company dislikes it; in fact, so violently that they may have you arrested on a serious charge. Many an innocent experimenter has gotten himself into a lot of trouble doing this.

Never try to make hydrogen gas without some knowledge of safety appliances to be used on the apparatus. It is about as quick a way to put your eyes out as there is.

If you are using storage batteries in your wireless set, and they fail to give proper voltage, or get too hot, don't try to fix them yourself, as they can be very easily ruined. A garage man can't fix in a day what you can "unfix" in 10 minutes.

Don't light matches around storage batteries to see if they are working properly. When operating they liberate a gas which is at times very explosive. Use a pocket flashlight.

If you are disturbed by alternating currents interfering with your wireless receiving set turn your aerial in another direction. It may help.

If you can get your wireless instruments silver plated, do so by all means, as silver is a much better conductor than nickel, and high frequency currents such as are used in wireless work travel almost entirely on the surface of switches.

If you are intending to buy any instrument and don't know the size, range, adaptability to your requirements, etc., don't be afraid to ask the manufacturer about the instrument. Even if he does have a catalogue, he will be glad to give you any additional information you desire.

When experimenting with 110-volt current always have a pair of 10 amp. fuses in circuit. It will stop a lot of pyrotechnics if something goes wrong.

Don't paint the stand that you intend to mount your instruments on. Paraffine is better; it don't allow so much current to leak through.

Contributed by WARD B. BABCOCK.

Rust spots on nickel can be treated with *Grease*, and after several days rubbed with a rag saturated with a few drops of *Hydrochloric Acid* in *Ammonia.* Parts should be thoroughly rinsed, dried and polished.

Aluminum Polish.—An emulsion of equal parts of *Rum* and *Olive Oil* can be used for cleaning aluminum. *Potash Lye*, not too strong is also effective in brightening aluminum; *Benzol* is also used.

A good polish for aluminum consists of a paste formed of *Emery* and *Tallow*, the finish luster being obtained by the use of *Rouge Powder* with *Oil of Turpentine.*

WITH THE AMATEURS

Our Amateur Radio Station Contest is open to all readers, whether subscribers or not. The photos are judged for best arrangement and efficiency of the apparatus. To increase the interest of this department we make it a rule not to publish photos of stations unaccompanied by that of the owner. Dark photos preferred to light toned ones. We pay each month $3.00 prize for the best photo. Make your description brief. Address the Editor.

AMATEUR RADIO STATION CONTEST.

Monthly Prize, $3.00.

This month's prize winner.

WIRELESS STATION AND ELECTRICAL LABORATORY OF FRANK H. BROOME.

The accompanying photo shows the sending and receiving outfits, also the main switchboard controlling the other laboratory and experimental apparatus, most of which is on a slate table not shown in the photo.

The wireless receiving outfit is of the semi-cabinet type, most of the instruments of which have been described by the owner in *The Electrical Experimenter* during the past year. All of the instruments are of the owner's design and make, and have proved of exceptional worth. They consist of a loading coil, loose coupler, variable and adjustable condensers, crystal detector and 'phones. The horn was used in connection with a receiver in receiving from WHB, NAH and other near-by stations.

Mr. Frank Broome is an Ardent Radio and Electrical Student. Here We See Him Surveying a Mast Site.

Below: The Radio Laboratory of Mr. Broome is Up-to-date and Contains Transmitting and Receiving Apparatus with Amplifier.





The present sending set consists of a 1-inch coil, operated in connection with an electrolytic interrupter on 110 volts alternating current; Leyden jar condenser, helix, hot-wire ammeter and key. Aerial is "T" type, 40 feet high and 100 feet long.

The aerial and lightning ground switch are both conveniently located, and can be operated from the switchboard panel.

The laboratory apparatus consists of step-down transformers, rectifiers, arc lamps, electric furnaces, storage batteries, etc., all of which are home-made. Tools and raw material are conveniently kept under the wireless table.

The station is over five years old, and during that time *The Electrical Experimenter* or its predecessor, *Modern Electrics*, was always to be found in its library.

FRANK H. BROOME.

Roselle Park, N. J.

RADIO OUTFIT OF JACOB WEISS.

I take this occasion to enter my station in your monthly contest. My station consists of a 1-kw. closed-core transformer (made by Queen & Co.), pancake oscillation transformer, rotary gap, consisting of motor-driven disc containing 13 studs (r.p.m. 6,000), and three Murdock condenser units. I use a break-in system, eliminating the aerial switch, and a magnetic key. The key operates the magnetic relay, which in turn operates the break-in relay. My transmitter is in the basement of my home and my receiving set is in the dining room on the first floor. I use a small Pittsburgh step-down transformer on 110 volts to operate a relay type motor starter. The relay for the motor is energized by a small foot-plate push mounted on the floor under the table.

My receiver consists of a loose coupler, primary and secondary rotary condensers and Audion amplifier, with 2,000-ohm 'phones. There are of course the necessary batteries and resistances to go with the audions. I use the series-shunt system for condenser on the primary coil.

I have no trouble in getting the distant stations very well. On Oct. 18 last I heard N.A.W. very plainly. I have held communication with Western stations regularly at such times as I have happened to be at home. During the winter months I worked 8 P.P., 8 A.M., 9 K.U., and was received at a station in Chicago, Ill., and at Winnetka, Ill. Also I have worked stations in Wheeling, W. Va.; Cleveland, O.; Little Valley, N. Y., and 8 O.Z., Pennsylvania.

I hold a certificate of the American Radio League as an official relay station; also first-grade commercial license. I am a regular subscriber to *The Electrical Experimenter* and find it excellent in its contents and suggestions.



Mr. Weiss Gets Excellent Results With His Radio Receiving Set.

JACOB WEISS, Asso. M. I. R. E.

Port Washington, L. I.

G. L. LA PLANT'S RADIO STATION.

I give here a brief description and photograph of my station, and would be pleased to have you publish them in your journal. The receiving apparatus consists of an R. J. 5 Audion detector, Blitzen receiving transformer and rotary variable condenser; also three pairs of 2,000-ohm 'phones. The transmitting set is composed of a Blitzen 1-kw. transformer, rack type condenser, oscillation transformer and Marconi type discharger. As the discharger is extra large I will give the dimensions for those who wish to build one. It is made of a hard rubber disc 10 inches in diameter, ¼ inch thick, with 13 studs on the side of the disc placed ¾ inch from the outer edge. The motor is a Robbins & Meyers 1/10-hp. style, running at 2,400 r.p.m. The aerial consists of four No. 14 H. D. W. P. copper wires spaced 2½ feet apart and is 80 feet high and 150 feet long. It is insulated with Electrose 4-inch insulators.



1 KW. Transmitting Set and Also Receiving Apparatus of G. L. La Plant's Radio Station.

I am a member of the Central Association, American Relay League and also corresponding secretary of the Hawkeye Radio Association. My call is 9.K.T.

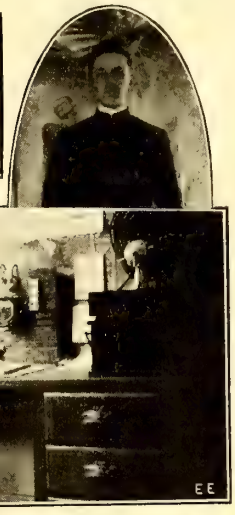
St. Anthony, Ia. G. L. LA PLANT.

CHARLESTOWN NAVY YARD RADIO CLOSED.

While the divisional radio is being secured the wireless station at the Charlestown, Mass., Navy Yard will be closed and all messages will be received at the Chelsea station. This will be for several months. The station at the navy yard has been dismantled and the apparatus has been set up at the Chelsea station. Messages received at Chelsea will be sent by "wire" to the Charlestown station.

J. W. ALLEN AND HIS WIRELESS "LAB."

The illustration herewith depicts my wireless station. At the left is the receiving set, consisting of a loose coupler, two specially designed silicon detectors, a double slide tuner, a large variable condenser and fixed condenser. I have two aerials,



Mr. J. Wyman Allen, owner of the Experimental Radio Station Shown Below.

Below: Well Arranged Radio Set Mounted on Desk.

one six-wire aerial 90 feet long and 60 feet high, for sending, and one two-wire aerial 200 feet long and 60 feet high, for receiving. Either or both of these aerials may be switched on for receiving by means of the two two-point switches seen on the front of the receiving set. The set is wired up so that by manipulating the switches on the front of the cabinet the hook-up may be changed from a loose coupler to a double slide tuner set, and the variable condenser may be shunted between the aerial and ground or may be switched in series with aerial. I have a 2,000 ohm double head set and a 1,000 ohm single head set. My sending outfit is a ¼ k.w. set with a Clapp-Eastham rotary gap. I have no aerial switch as I use a break-in system. My receiving apparatus has a range of 100 to 3,000 meters wave length.

J. WYMAN ALLEN.

Beverly, Mass.

HAMMOND PROFFERS INVENTION TO NAVY.

John Hays Hammond, Jr., recently laid before Secretary Daniels and ordnance experts of the navy the wireless device which he has perfected to direct torpedoes discharged from submarines.

Secretary Daniels declined to give the mechanical make-up of the device. He said, however, it may be of incalculable advantage to the navy.

H. LIGHTNER'S REMARKABLE POCKET RADIO SET.

After seeing the wireless sets pictured in your Prize Contest Department I decided to submit a snapshot of a pocket wireless designed and constructed by myself.

The outside dimensions of this set are 8x4x2 inches, while the weight is only two pounds without the receivers. I use one of the E. I. Co. dime galena detectors and find it extremely sensitive. My headset consists of two 2,000-ohm Brandes' Superior type receivers, which are very good. My condenser and coils are of my own make and have sufficient inductance to bring in high wave-length stations.

This set is able to receive NAA, WSL, WCX; several lake boats, including the C. & B. boats, and numerous unidentified stations. NAA comes in loud enough to be heard 26 inches away from the 'phones. By using a bed spring as an aerial I have picked up the first three stations above mentioned.



Mr. Lightner Has Perfected an Efficient Pocket Radio Receiving Set.

HERBERT LIGHTNER.

Alliance, O.

Amateur News

The Institute of Radio Engineers' October Meeting.

At the regular monthly meeting, held on Oct. 6, at Columbia University, New York City, The Institute of Radio Engineers had the pleasure of hearing a timely paper on the subject of "The Training of the Radio Operator," by Mr. M. E. Packman, professor of Radio Telegraphy at Dodge's Telegraph, Railway and Wireless Institute, Valparaiso, Ind. Mr. Packman's discourse covered the method found best for instructing embryo radio operators, and covers such matters as the type of apparatus best suited to transmit code practise signals, number of subjects to be taught, length of time required to thoroughly teach the operator the necessary rudiments of electricity and radio operation, etc.

The point was brought out that in most cases, and taking for granted that each applicant to the school has a fairly good general education, such as given in grammar schools, that a finished radio operator could be turned out in about six months. About 600 students have been enrolled annually at this school and one-third of them are radio students.

The pupil is taught typewriting and penmanship as well as all necessary wireless instruction for the reason that most telegraphic and radio messages today are copied direct on the typewriter and, of course, in any event the wireless man in charge of a station should be a first-class penman. Geography and other practical branches of study are also gone into at this school with good results. The practical side of the radio operating profession is also covered, so far as becomes possible in the short length of time the student has at his disposal. This covers such matters as the routing of messages, repetition of messages, the various codes and modifications as well as abbreviations in use internationally, etc. The fact was brought out that most of the radio operators graduated are in the Marconi service, as this company controls the major portion of the radio business to-day. The short-comings of young radio operators were brought out and the speaker offered several suggestions tending to offset these, if proper training was given in the school.

Boston Radio Amateurs, Attention

Radio amateurs located in or near Boston interested in forming a wireless association with headquarters and a central station will do well to inquire for particulars at The Young Men's Christian Union, 48 Boylston St., Boston, Mass.

Maple City Radio Club of Hornell, N. Y.

The "Maple City Radio Club" was organized on Oct. 2, 1915, with the following officers: Guy Loper, president; James Stephens, vice-president; Robert Shults, secretary; Benedict French, chief operator, and the following as members: Raymond Wright, Carl Mead, Sidney Emerson, Carl Chapman, Walter Howard.

All correspondence should be addressed to the secretary at 179 Main Street, Hornell, N. Y.

Bronx Radio Club.

At the last October weekly meeting of the Bronx Radio Club of New York, the election of new officers was held, the result of which was as follows: M. Haber, president; J. Smith, vice-president; A. Schoy, business manager; H. Berlin, secretary; A. Richter, treasurer.

A lecture was delivered by one of the members on "The Theory of Wireless Transmission."

Lectures are given at every meeting by the more advanced members of the club, dealing with timely topics of wireless or electrical interest.

The club will be glad to communicate with other societies and individuals desirous of having information or particulars of the proceedings of this organization.

All communications should be addressed to the secretary, 705 Home St., Bronx, New York. Those wishing to call on the president may do so at his home, 670 E. 170th St., Bronx, New York.

Ames, Iowa, Has Radio Society.

The second annual convention of the Hawkeye Radio Association was held at Ames, Iowa, on Sept. 1 and 2. It was well attended and proved a success in every way. The meeting on Sept. 1 was attended by wireless amateurs from all over the State. The following officers were elected: President, Ralph Batcher, 131 Hyland Ave., Ames, Iowa; Vice-President, W. P. Rathert, Cresco, Iowa; Secretary, A. B. Church, Lamoni, Iowa; Treasurer, Hollis Sels, 131 Hyland Ave., Ames; Corresponding Secretary, G. L. La Plante, St. Anthony, Iowa.

The association has had published a monthly bulletin containing from one to three pages filled with articles of interest to the members. This will be continued and enlarged during the next year. Information will be given applicants by the officers, regarding membership. We are trying to get a complete directory of the amateurs residing in Iowa, and the president would be glad to obtain any information relating to such a directory.

Much interest was afforded the members by a large display of the most modern types of radio apparatus, which was kindly loaned for the occasion by some of the well-known wireless manufacturers.

RADIO CLUBS ATTENTION!

We are always pleased to hear from young Edisons and Radio Clubs. Send a write-up of your Club with photos of members and apparatus to-day to: Editor "Amateur Gossip" Section, The Electrical Experimenter, 233 Fulton St., New York City.

Savannah, Ga., School Wireless Licensed.

Arthur Funk, amateur radio operator, who has for the last two years been perfecting the station he has now installed on top of the High School at Savannah, Ga., recently received his operator's license from the Government.

It is a license for "Commercial, experimental and instruction purposes," and was obtained primarily to enable him to pursue research work in connection with the problems of the station. His call letters are 4AH.

Mr. Funk is also endeavoring to install a wireless 'phone, working along a theory of his own, and has already begun work on the instruments. He is working independent of the lines followed by experimenters in the recent Government successful wireless 'phone tests.

The station, which was constructed entirely at the High School, has a sending radius of 100 miles and the operator has picked up messages from Colon, Panama and the naval stations at Guantanamo, Cuba. Among other devices that have been recently installed is a marble switchboard, and the lightning switch has been placed outside the school to minimize the danger from that source.

Middletown Scientific Association Holds 410th Meeting.

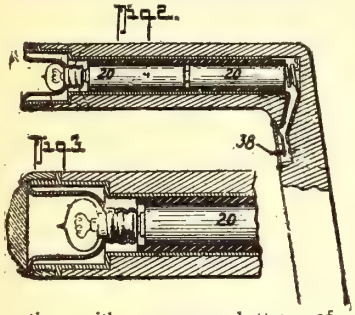
The 410th meeting of the Middletown Scientific Association was held in the Scott Laboratory of Physics at Wesleyan University, on the evening of Oct. 13 last. The address was by Professor Walter Guyton Cady, Ph.D., professor of physics in Wesleyan University, on the subject, "Wireless Telegraphy." The lecture was illustrated with experiments and lantern slides.

LATEST PATENTS

Flashlight for Canes and Umbrellas.

(No. 1,151,114; issued to Gustav Matthies and August Rehberg, Jr.)

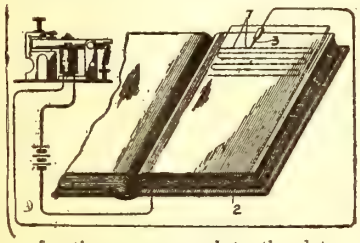
This patent covers a neat arrangement for a small flashlight bulb, together with necessary battery of miniature dry cells and switch for controlling the lamp circuit in a cane. The drawing clearly shows how these parts are arranged and the lens of the flashlight is indicated while the push button appears at 38. The miniature dry cells are shown at 20.



Electric Apparatus Enabling the Blind to Read.

(No. 1,149,547; issued to Henry Tideman.)

Intended to aid the blind to read, makes use in general of special books containing a perforated page, which

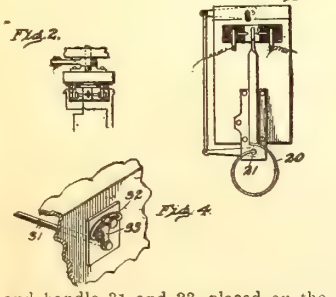


perforations correspond to the dots and dashes of the Morse telegraph code. A regular sounder (or a telephone receiver type sounder) may be used, together with battery, as shown in diagram, and this circuit is opened and closed by means of a metal stylus 3, which is moved over the perforations 7, on the page. Under the page lies a metal plate, which is connected with the opposite side of the circuit. Several other unique schemes are covered in this interesting patent.

Thermostatic Circuit-Closer for Incubators.

(No. 1,151,142; issued to Louis L. White.)

A modified form of thermostatic circuit closer for incubators and the like, the closing and opening "valves" of which are easily adjusted for, as by means of a dial

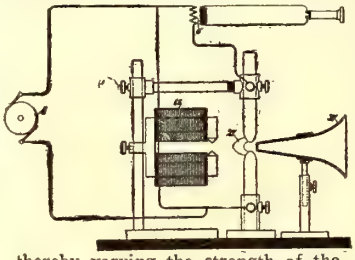


and handle 31 and 33, placed on the exterior of the incubator. The handle 33 is secured to a shaft 31, which in turn connects by means of levers to the pivot 21. A thermo-electric element 20, which is of circular form as perceived, is composed of strips of brass and steel soldered together. This thermostat is used to regulate a motor or other electrical attachments for opening and closing dampers or doors, so as to keep the incubator at a practically constant temperature.

Arc Type Telephone Transmitter.

(No. 1,150,266; issued to Walton Harrison.)

A telephone transmitter intended to be used with heavy currents, such as for loud-talking telephone circuits, wireless telephony, etc. The air waves set up by speaking into the horn 37 are caused to impinge against the arc at 27. Controlling electro-magnets, which aid in the operation of this arrangement, it is said, are shown at 15. It acts on the principle that the variable air currents, corresponding to the voice waves, will cause the arc 27 to change in its length and resistance,

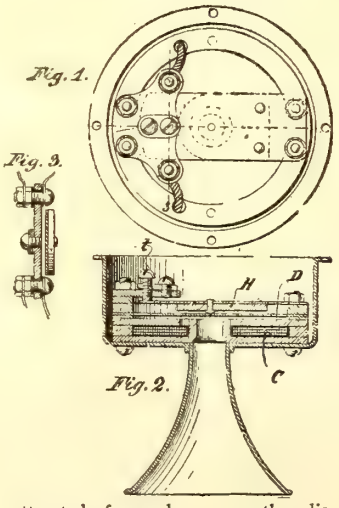


thereby varying the strength of the current through an induction coil 6, which is joined to a loud-speaking telephone, etc.

Electro-Magnetic Sound Producer.

(No. 1,147,016; issued to Leo Grubman, assignor to Electric Spark Appliance Co., Inc.)

A novel form of electro-magnetic sound producer, intended for use particularly on Ford automobiles, whose magnetos yield alternating current. This horn has an electro-magnet coil C, mounted in a magnetic or iron frame with pole pieces, as drawing shows. The flux from the pole pieces reacts on to a distinct magnetic armature H. This, when

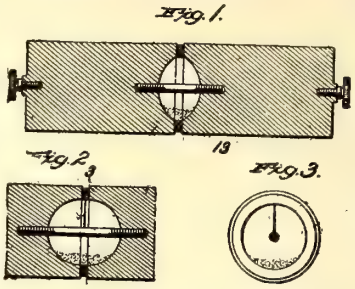


attracted forward, moves the diaphragm proper "D" naturally, and also in its return movement, the diaphragm "D" acts resilliently on the armature H. By this action the inventor claims to attain the best results for this form of construction. A tuning screw *t* is provided for properly adjusting the armature vibration period. No interrupter is used.

Radio Telegraphic Coherer.

(No. 1,150,111; issued to Edwin R. Gill.)

Another advance in the design of coherers for radio telegraphic or other requirements. The inventor lays great stress on the proper formation of the spherical chamber 13, in which metallic or other filings are contained. Also he mentions that if

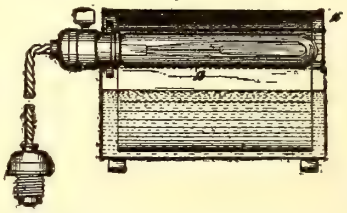


these filings are of the proper size, and also by utilizing a periodically changing sweeper, or mixer, that it is possible to obtain very regular and reliable results with a coherer so constructed. Again he mentions the use of a number of such coherers on a common circuit and each one of these coherers to be successively but independently switched into circuit by proper means, and thus while one is decohering another one will be in circuit to perform the regular function of such a device.

Electric Humidor.

(No. 1,145,218; issued to Walter E. Schimmel.)

This type of humidor, used to produce a damp vapor from water or other liquid, utilizes an electric lamp

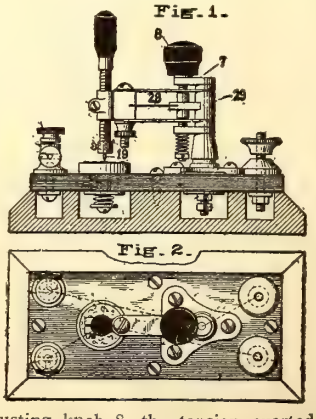


13, placed in the upper part of a chamber 9. In order to improve the operation of this device blotting paper or some other good absorbent is supported in the vaporizing chamber from rods 16, and this causes the water to be drawn up near the lamp and thus the vaporization is greatly enhanced. The moist vapor produced in this way can then escape through perforations in the top of the containing vessel.

Radio Detector Stand.

(No. 1,152,444; issued to Augustus K. Sloan, Jr.)

Another radio detector stand which embodies several good features, it seems, with respect to the spring tension adjustment for the "cat-whisker" electrode. By means of an ad-



justing knob 8, the tension exerted by the metal point electrode 19 is very accurately adjustable owing to the unique construction, which employs a flat tension spring 28, secured to a movable block 29. This block 29 can be raised or lowered independently by turning knob 8. Also the electrode 19 may be moved over the face of the crystal rapidly owing to the novel construction of pillar 7, which permits the whole spring arm arrangement to be swung from side to side.

Wireless Condenser.

(No. 1,150,895; issued to Augustus Kellogg Sloan.)

A newly devised variable condenser suitable for radio or other circuits and comprising a number of concentrical metal tubes nested together as

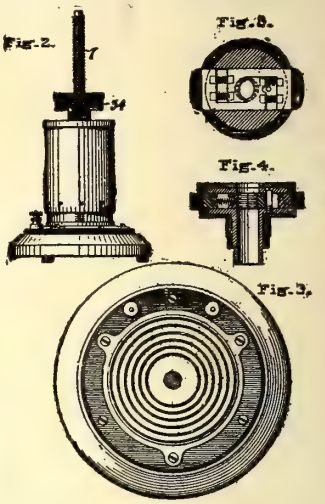
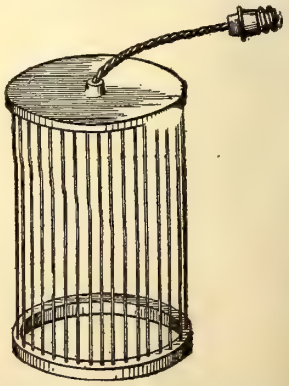


illustration shows. Every other tube connects to one pole of the condenser and one set of tubes may be moved up and down to vary the capacity by means of a special insulated handle 34. This handle is threaded and the nut within same is made in two halves; thus it is possible to compress the nut sections so that the moving element can be slid up and down the threaded vertical rod rapidly. For the fine adjustment the handle 34 is released and the split threaded nut engages the screw 7, so that the plates can be accurately and closely varied in their relative position.

Electric Insect Trap.

(No. 1,150,835; issued to Joseph Satinover.)

It is proposed with this device to



electrocute insects of all kinds by arranging two sets of oppositely charged wires or metallic rods to form a cage, as perceived in the illustration. These oppositely charged wires are bare, of course, and spaced a short distance apart. They will work on a 110 volts and alternating current or direct current, the same as that supplied for lighting.

COPIES OF ANY OF THE ABOVE PATENTS SUPPLIED AT 10c. EACH.

Phoney Patents

Under this heading are published electrical or mechanical ideas which our clever inventors, for reasons best known to themselves, have as yet not patented. We furthermore call attention to our celebrated Phoney Patent Offizz for the relief of all suffering daffy inventors in this country as well as for the entire universe.

We are revolutionizing the Patent business and OFFER YOU THREE DOLLARS ($3.00) FOR THE BEST PATENT. If you take your Phoney Patent to Washington, they charge you $20.00 for the initial fee and then you haven't a smell of the Patent yet. After they have allowed the Patent, you must pay another $20.00 as a final fee. That's $40.00 ! ! WE PAY YOU $3.00 and grant you a Phoney Patent in the bargain, so you save $43.00 ! ! When sending in your Phoney Patent application, be sure that it is as daffy as a lovesick bat. The daffier, the better. Simple sketches and a short description will help our staff of Phoney Patent examiners to issue a Phoney Patent on your invention in a jiffy.

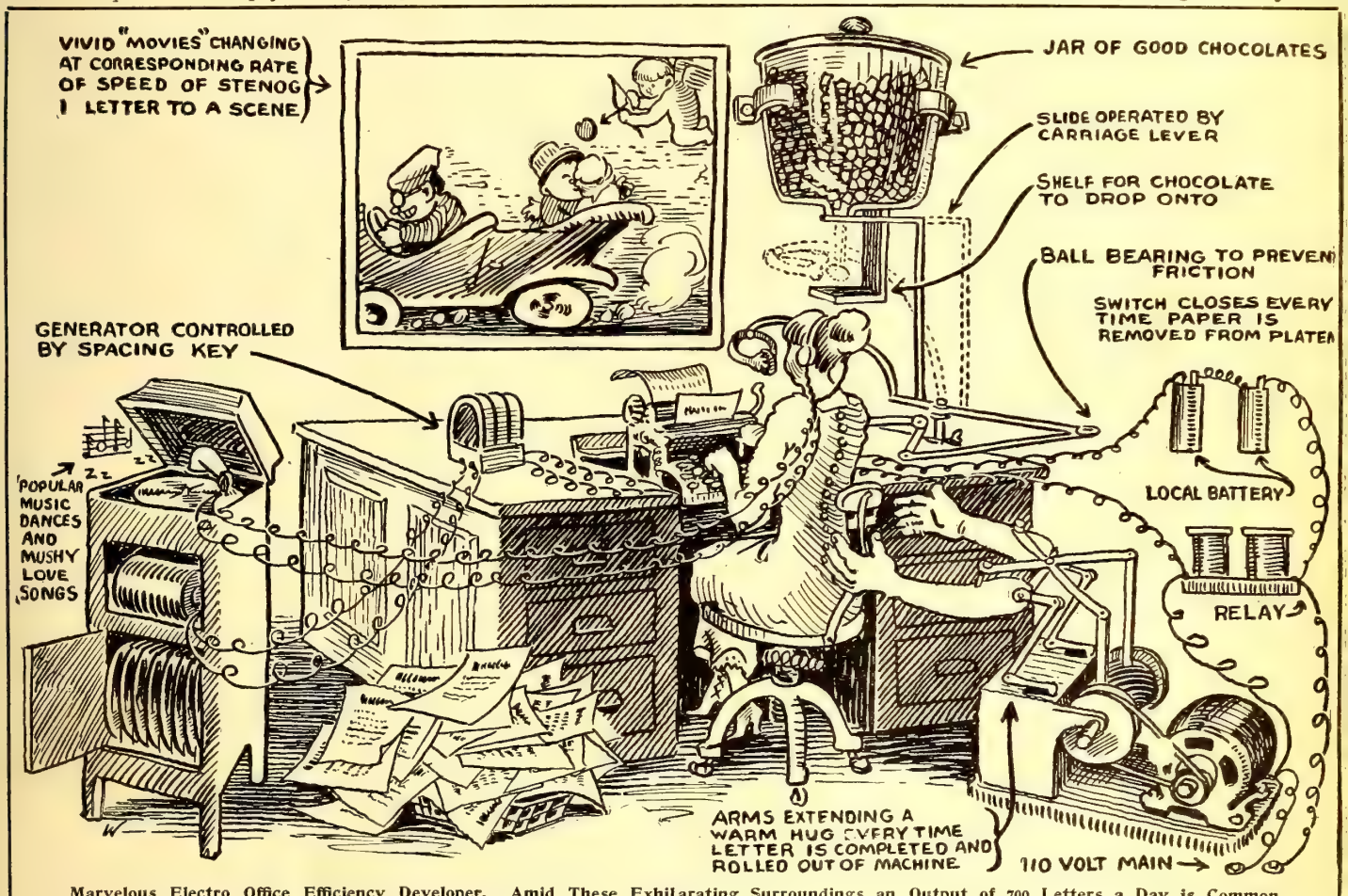
PHONEY PATENT OFFIZZ

PHONEY PATENT PERPETRATED BY WATT A. LUNKHED

No. Px6 $\sqrt{Lx4}$ **ELECTRO OFFICE EFFICIENCY DEVELOPER** **Pat. Applied Externally**

To all who should worry:

Be it known that I, Watt A. Lunkhed, of the City of Oful State of Affairs, have deliberately sacrificed my fortune and last ray of sanity in devising, developing and perfecting this apparatus for alleviating the troubles of all poor stenographers who are troubled with a lack of ambition. It has worked perfectly under all conditions. Many girls preferring it to the effeminate attentions of mushy office managers, the latter are not required on the payroll any longer.



Marvelous Electro Office Efficiency Developer. Amid These Exhilarating Surroundings an Output of 700 Letters a Day is Common.

The results are based upon the formula $E. = \frac{P.}{W.}$ where E. = efficiency P. = pleasure and W. = work. By increasing both factors of the fraction it is apparent that the results will not be changed, thus doubling the work can be offset by increasing the pleasure an equal amount, thereby retaining the same efficiency, and vice versa.

The apparatus is arranged as per attached drawing and its operation is as follows:

After the stenographer has taken all the letters (700 a day is common when this machine is installed), she sits down, inserts the letter-head and starts typing. As she presses the keys real movies appear on the screen in front of her. The scenes appear in perfect synchronism with the striking of the keys, therefore fast work is necessary so she can find out quickly how it all ends.

A touch on the spacing bar automatically turns lose the Victrola with a lot of love melodies and mushy ballads, in perfect keeping with the movies.

When the carriage is pushed back after each line, a system of levers (not lovers) delivers a luscious chocolate to her rosy lips. The supply of delicacies is contained in the large glass jar at the right, and if the boss is of a sporting disposition he can offer prizes to the stenog emptying the jar first.

The master stroke of my invention is found in the hugging attachment operated each time a letter is removed from the machine. The motor operated arms clasp her firmly but tenderly around the waist and hug her as good as any mere man without the attendant smell of cheap tobacco, which latter ofttimes accompany this blissful pastime. For best results this motor should be at least two horse-power —this is a small detail that should be carefully attended to.

For best results with this recipe for efficiency it is absolutely necessary that only pure ingredients be used—thus purely emotional motion pictures—pure high grade chocolates, and purely sentimental music should only be employed.

This machine has been tested by all the crowned heads and blockheads of Europe and New Zealand, proving in every case that woman, with the aid of this machine, is complete in herself, does not require the association of males and therefore should rule herself.

In testimony thereof I therefore bury here my tame seal on this day of devotion and supplication to Woman Beautiful in this City of Oful State of Affairs.

WATT A. LUNKHED.

By his Attorney:

S. A. TROMBLY,
Worcester, Mass.

Witnesses:

G. WATASINCH,

LILL Q. PIDT,

ROMEO CHEESIT.

OFFICIAL LIST OF LICENSED RADIO AMATEURS NOT TO APPEAR IN NEW GOVERNMENT CALL BOOK. PRESERVE THIS LIST FOR FUTURE REFERENCE.

Amateur Radio Stations Licensed by the Bureau of Navigation During the Month of July, 1915.

Call signal.	Owner of station.	Location of station.	Power in watts.
FIRST DISTRICT.			
1NV	Campbell, Margaret L..	14 High St., Rockport, Mass.....	100
1AE	Durham, Wison N.....	Oakland, Me.	72
1HQ	Eberlein, Geo. H.....	15 Hastings St., Greenfield, Mass...	100
1MF	Entwistle, Warren R...	41 C St., Lowell, Mass.....	30
1TM	Jackson, Edw. A.....	15 School St., Newport, R. I.....	180
1HJ	Johnson, Edw. C., Jr...	198 Randolph Ave., Milton, Mass..	550
1GK	Lang, Stanley W.....	799 Tyler St., Pittsfield, Mass.....	100
1MT	Lindsay, Alex. M., Jr..	Plymouth, Mass.	770
1OK	Morash, Arthur F.....	236 Chestnut St., Cambridge, Mass..	250
1HT	Oliver, H. E.....	235 Springside Ave., Pittsfield, Mass.	100
1HS	Reese, Lauren A.....	181 Woodlawn Ave., Pittsfield, Mass.	32
1KL	Stocker, Clarence I....	65 N. Franklin St., Lynn, Mass.....	100
1TK	Stiness, Samuel	260 Broad St., Central Falls, R. I...	550
1OL	Swanson, Richard	13 Hale St., Rockford, Mass.....	30
1OG	Tarr, Gertrude E.....	8 High St., Rockport, Mass.....	100
1LJ	Taylor, Jas. W.....	62 Tremont St., Boston, Mass.....	35
1HX	Vogel, Edw. A.....	49 Curtis Ter., Pittsfield, Mass.....	40
1VC	Zander, Joseph T.....	34 South St., Ansonia, Conn.....	25
SECOND DISTRICT.			
2AGE	Bedell, Walter R.....	35 Hooker Ave., Poughkeepsie, N.Y.	40
2AGM	Buttner, Edwin	1160 Third Ave., New York, N. Y.	40
2SE	Godley, Paul F.....	106 Leonia Ave., Leonia, N. J.....	880
2AGO	Norris, Robert P.....	906 Marks Ave., New York, N. Y...	16
2AFT	Oudin, C. Folger.....	7 Union St., Schenectady, N. Y....	1,000
2AGP	Ripperger, Clinton.....	147 Wisner Ave., Middletown, N. Y.	12
2AGQ	Rosenberg, Uda B.....	2116 Honeywell Ave., New York...	10
2AGT	Schleckser, Raymond R.	12 Fabyan Pl., Newark, N. J.....	10
2AGV	Sievering, Harry W....	54 Navin Pl., Newark, N. J.....	30
2AGN	Williams, E. Malcolm..	Troy High School, Troy, N. Y.....	40
2AGU	Zimmermann, William..	765 Hunterdon St., Newark, N. J..	100
THIRD DISTRICT.			
3IC	Dingee, Alex, L. M...	Paoli, Pa.	990
3GP	Hettinger, Alfred C...	128 S. Church St., Allentown, Pa...	20
3IA	Mahlmeister, E., Jr....	1801 N. 13th St., Philadelphia, Pa...	250
FOURTH DISTRICT.			
4AT	Hall, Marvin S.....	687 N. Boulevard, Atlanta, Ga.....	327
4BD	Pinkston, Jeter, Jr....	107 Gordon St., Valdosta, Ga.	550
4AY	Sanders, Tye C	239 Woodward Ave., Atlanta, Ga....	575
4AV	Stringfellow, Geo. P...	Ortega, Fla.	330
4AR	Summers, C. H., Jr....	501 E. Main St., Gainesville, Fla....	120
4AD	Walker, Jas. E.....	Milledgeville, Ga.....	1,000
FIFTH DISTRICT.			
5CW	Ansley, Hewlette L....	1428 N. 12th Ave., Birmingham, Ala.	250
5CX	Holland, Jesse W.....	406 Granbury St., Cleburne, Tex....	100
5CZ	Leroy, Louis	Memphis, Tenn.	120
5DA	Mitchell, Erwin H.....	1012 Government St., Mobile, Ala..	250
5CY	Ward, Robert P.....	233 Orchard St., Georgetown, Tex..	504
5DB	Wood, Ross	726 Speight St., Waco, Tex.....	300
SIXTH DISTRICT.			
6IC	Andrews, Carl	2286 Olive St., Long Beach, Cal....	100
6IB	Bauchou, Leon J.....	Mayfield, Cal.	24
6PC	Bumbaugh, H. L.....	Lemon Grove, Cal.	500
6JO	Carroll, Lionel H.....	427 Hunter St., Stockton, Cal.....	100
6QR	Chase, Ralph N.....	R.F.D. No. 4, Santa Ana, Cal.....	1,000
6FF	Cosgrove, Clarence E...	435 Hanover St., East Oakland, Cal..	250
6MU	Eddy, Myron F.....	1232 Alice St., Oakland, Cal.....	500
6IA	Griffiths, Walter M....	1022 1st St., Napa, Cal.....	1,000
6IK	Grotzinger, Clarence E.	Corona, Cal.	12
6PU	Hamilton, Howard B...	1218 N. 6th St., Redlands, Cal.....	100
6GY	Hemenway, Walter D..	Winters, Cal.	36
6IN	Ivins, George	5102 S. Wilton Pl., Los Angeles, Cal.	220
6IL	Mahler, Jas. J., Jr.....	233 Hawthorne St., San Diego, Cal..	280
6IP	Marsh, Hallan N.....	1225 W. Brookes Ave., San Diego, Cal.	330
6GH	McCarthy, John J.....	3913 26th St., San Francisco, Cal...	50
6NS	Neville, Glen	417 S. 1st St., San Jose, Cal.	30
6IY	Plimpton, Roe	2508½ Palm Drive, Los Angeles, Cal.	330
6SR	Shelton, R. O.....	3443 5th St., San Diego, Cal.	467
6EQ	Smith, Clarence W.....	333 Naples St., San Francisco, Cal..	50
6PD	Somers, Wm. A.....	2057 W. 29th St., Los Angeles. Cal..	330
6OY	Toft, Frank	Mountain View, Cal.	24
SEVENTH DISTRICT.			
7KF	Duncan, Andrew J.....	3919 Burke Ave., Seattle, Wash.....	50
7WH	Harrington, Wilbert I..	Y. M. C. A., Seattle, Wash.	352
7LH	Hill, Leroy C.....	4824 76th St., Portland, Ore.....	50
7LB	Mahan, LeRoy J.....	644 Exchange St., Astoria, Ore.....	1,000
7FJ	Miller, Clinton E.....	394 11th St., Portland, Ore.	50
7MF	Tingstad, Anton R.....	2128 Wilkinson St., Tacoma, Wash..	50
EIGHTH DISTRICT.			
8MX	Cooke, Lovell	R.F.D. No. 3, Gobleville, Mich.....	120
8AF	Frey, Fred'k. E.....	155 Poplar St., Mansfield, Ohio....	330
8OH	Harter, Raymond.....	Spencerville, Ohio	250
8LI	Hill, Dormand S.....	2 Taft Ave., Detroit, Mich.	440
8FK	Hosley, Fred'k D.....	900 South Ave., Rochester, N. Y. ..	24
8LV	Krommer, Frank	811 York St., Cincinnati, Ohio.....	18
8MO	Magregor, James E.....	211 Gold Ave., Grand Rapids, Mich..	420
8RP	Merrill, John P.....	608 Crescent Ave., Buffalo, N. Y....	40
8MA	Metzger, Milton	121 Lane St., Bucyrus, Ohio.....	440
8NS	Moore, Allan N.	36 W. La Belle St., Grand Rapids, Mich.	100
8ME	Preece, Richard, Jr.....	2124 N. 12th St., Toledo, Ohio.....	500
8SP	Reid, Thos. A.....	411 S. Limestone St., Springfield, O.	660
8AC	Richmond, Norman E..	5811 Lexington Ave., Cleveland, O..	550
8HH	Schaming, John P.....	3114 McClurg, St., Pittsburgh, Pa...	12
8DG	Shiley, Charles	110 Washington St., Kalamazoo, Mich	20
8CP	Smith, Newell R.....	525 N. Main St., Wellington, Ohio..	550
8IG	Sternfield, Chas. B....	516 W. Cedar St., Kalamazoo, Mich..	550
8QA	Struchen, Raymond S..	Sterrettania, Pa.	36
8OV	Wahl, Arthur F.....	Pine Ridge, Buffalo, N. Y.....	550
8OV	Wahl, Wilburt C.....	Pine Ridge, Buffalo, N. Y.....	550
8ACG	Welty, C. W.....	Pandora, Ohio	550
NINTH DISTRICT.			
9CZ	Chamberlain, A. Lee...	1040 E. Sixth Ave., Des Moines, Ia.	1,000
9UL	Cheyne, Thos. L.....	526 West Drive, Indianapolis, Ind...	225
9UI	Cottrell, Hale T.....	1229 St. Ann St., Owensboro, Ky....	1,000
9HV	Custer, Alfred E.....	1432 S. Washington St., Denver, Colo	250
9UM	Erickson, Edward H...	627 W. Superior St., Ft. Wayne, Ind.	495
9JF	Erskine, Vernon.....	Kennebec, Iowa.....	50
9UK	Graybill, Donald R.....	Polo, Ind.	550
9UO	Hegge, Adolph.....	Hatton, N. Dak.	36
9UH	May, De Witt W.....	1227 Spaight St., Madison, Wis.....	432
9UJ	Neumann, Adelbert G..	1616 Wells St., Milwaukee, Wis.....	250
9UP	Paetzold, William H....	4302 Farlin Ave., St. Louis, Mo.....	36
9UN	Smith, Joe L.....	109 N. Highland St., Chanute, Kans.	500

Amateur Radio Stations Licensed by the Bureau of Navigation During the Month of September, 1915.

Call signal.	Owner of station.	Location of station.	Power in watts.
FIRST DISTRICT.			
1IQ	Bishop, Donald S.....	211 Washington St., North Attleboro, Mass.	35
1TX	Brown, Louis.....	209 Blackstone St., Providence, R. I.	100
1HV	Chutter, George A.....	67 Church St., Swanton, Vt.....	550
1PK	Eastman, Damon L....	Norfolk, Mass.	50
1PE	Hardy, Jack.....	Littleton, Mass.	500
1SY	Hathaway, Samuel D...	126 Atlantic Ave., Marblehead, Mass.	500
1QT	Hovey, Arthur T.....	74 Woodcliff St., Boston, Mass.....	72
1KU	Lamb, Claude M.....	244 Federal St., Greenfield, Mass...	100
1MT	Mathewson, Oliver W..	34 Corona St., Dorchester, Mass....	36
1PL	Stratton, Rolland A....	215 Federal St., Greenfield, Mass...	40
SECOND DISTRICT.			
2FR	Ettlinger, Albert	202 W. 93d St., New York, N. Y....	12
2CB	Leeb, Henry Lorent...	166 Ralston Ave, South Orange, N.J.	561
2DZ	Tuna, Lawrence	182 Madison Ave., New York, N. Y.	24
2FB	Volke, Edgar	883 S. 19th St., Newark, N. J.....	15
FIFTH DISTRICT (No stations licensed in 3d and 4th Districts).			
5DG	Barr, Charles S.....	327 Parkway, Memphis, Tenn.....	1,000
SIXTH DISTRICT.			
6CD	Abbott, Clare C.....	4728 S. Western Ave., Los Angeles, Cal.	990
6BL	Betterly, Jack A.....	2500 Elm Ave., Long Beach, Cal...	250
6JE	Bradley, John	120 Julian Ave., San Francisco, Cal.	700
6VS	Brundige, Lamont J....	114 E. Hadley St., Whittier, Cal....	500
6BT	Cantelow, Elbridge M..	2515 Derby St., Berkeley, Cal.....	250
6FL	High, Freeman K., Jr.	726 W. 27th St., Los Angeles, Cal..	250
6PK	Latta, Paul, ...	2158 Woolman Ave., San Diego, Cal.	100
6MX	Macurda, Malcolm	1714 Harvard Blvd., Los Angeles, Cal.	500
6BV	Munzig, Arthur	217 Tribune St., Redlands, Cal.....	500
6BR	Peelle, Russell G.....	517 N. Washington St., Whittier, Cal.	540
6SD	Shaffer, Charley L....	450 W. Center St., Pomona, Cal...	100
6WV	Webb, Walter R.....	1306 W. 41st St., Los Angeles, Cal.	1,000
SEVENTH DISTRICT.			
7LC	Anderson, Leonard ...	218 Ninth Ave., N., Seattle, Wash..	1,000
7WC	Cates, Walter C.....	1704 Franklin St., Vancouver, Wash.	1,000
7JH	Hurtt, John	1067 E. Burnside St., Portland, Ore.	500
7NP	Pennell, Harry R.....	317 Cornell Road, Portland, Ore....	220
7JR	Tolmie, Jack R.....	1213 Columbia St., Seattle, Wash....	250
EIGHTH DISTRICT.			
8ES	Aber, Ernest M., Jr....	352 W. Ferry St., Buffalo, N. Y...	30
8KH	Angel, Jay L.....	R.F.D. No. 1, Bowling Green, Ohio.	50
8NL	Appel, Floyd	310 Short St., Erie, Pa.....	500
8LN	Butler, Harry F.....	456 Mahoning St., Lehighton, Pa. ..	900
8NN	Chester, Allan	50 E. Elm St., Norwalk, Ohio.....	550
8KU	Cookman, Murray R...	118 Glasgow St., Clyde, N. Y.....	20
8LT	Copp, Stanley R.....	5 W. Monument Ave., Dayton, O...	118
8OQ	Cross, Blakely E.....	47 Burr St., Gloversville, N. Y.....	18
8JE	Daniels, Le Roy.....	Litchfield, Mich.	40
8AIC	Feldstein, Milton	Toledo, Ohio (portable station).	40
8KM	Guest, Wesley T.	13 Babcock Ave., Silver Creek, N.Y.	24
8LZ	Hess, Elmer	4129 Carter St., Norwood, Ohio....	35
8AY	Irvin, Daniel L.....	Curwensville, Pa.....	660
8SD	Johnston, Clarence N..	1335 Hill St., Ann Arbor, Mich....	880
8QH	Kelly, Edward O.....	18 Stratford Park, Rochester, N. Y..	825
8RB	Leach, J. Gardner.....	White High School, Toledo, Ohio...	990
8IA	Lindsay, Percy H.....	172 N. Division St., Buffalo, N. Y..	24
8QC	Lucas, W. Gerald.....	63 E. Pine St., Gloversville, N. Y..	250
8LR	Magdeburg, Morris R..	1306 Spruce St., Ashland, Pa.....	100
8QN	Mann, Rolland	53 Good Ave., Buffalo, N. Y.....	36
8GF	McCowan, Jack.....	906 E. 8th St., Port Huron, Mich..	27
8KN	Odenkirk, Russell	332 N. Beaver St., Wooster, Ohio..	20
8LB	Palmer, Roland F.....	470 E. Butchel St., Akron, Ohio....	500
8OT	Pancoast, Maurice H...	R.F.D. No. 6, Lansing, Mich.....	36
8OY	Peck, George W.....	1014 Vine St., Scranton, Pa.....	1,000
8FY	Prince, Harmon	3214 W. 88th St., Cleveland, Ohio..	27
8GM	Root, Leland B.....	711 Utica St., Fulton, N. Y.....	250
8RX	Ryan, Theodore W....	1453 14th Ave., Detroit, Mich.....	33
8DB	Scoville, George I. C...	518 N. Jamison Ave., Lima, Ohio...	50
8MJ	Sherman, Fred.....	Benton Harbor, Mich	550
8NZ	Simcox, Paul C.....	403 N. 7th St., Cambridge, Ohio....	250
8QU	Spindler, Raymond	83 Saranac St., Rochester, N. Y....	23
8SE	Vickery, William J.....	40 Burr St., Gloversville, N. Y.....	18
8BV	Wagner, Wayne	18 East St., Ashtabula, Ohio.	440
8JD	Wing, Wills K.....	Scott High School, Toledo, Ohio....	550
8NI	Zimmerman, F. C., Jr...	15 Taft Ave., Detroit, Mich.	500
NINTH DISTRICT.			
9VU	Allman, John C.....	Crown Point, Ind	40
9VY	Bauer, George D.....	2133 Weisser Park Ave., Ft. Wayne, Ind.	500
9VP	Benson, Lester A.....	2706 Stoddard St., St. Louis, Mo...	500
9WE	Brandt, Erwin H.....	2314 Vliet St., Milwaukee, Wis.....	550
9WA	Coats, Roscoe J.....	820 S. Clinton St., Ft. Wayne, Ind..	250
9VS	Diffenderfer, Davis A.	2409 Harrison St., Ft. Wayne, Ind.	972

(To be concluded.)

OFFICIAL CODE CHARTS GIVING INTERNATIONAL RADIO SIGNALS, CONVENTIONS AND ABBREVIATIONS.

INTERNATIONAL MORSE CODE AND CONVENTIONAL SIGNALS

TO BE USED FOR ALL GENERAL PUBLIC SERVICE RADIO COMMUNICATION

1. A dash is equal to three dots.
2. The space between parts of the same letter is equal to one dot.
3. The space between two letters is equal to three dots.
4. The space between two words is equal to five dots.

A • —	Period . . . . . • • • • • •
B — • • •	Semicolon . . . . . — • — • — •
C — • — •	Comma . . . . . • — • — • —
D — • •	Colon . . . . . — • • •
E •	Interrogation . . . . . • • • •
F • • — •	Exclamation point . . . . . — — • • — —
G — — •	Apostrophe . . . . . • — — — — •
H • • • •	Hyphen . . . . . — • • • • —
I • •	Bar indicating fraction . . . . . — • • — •
J • — — —	Parenthesis . . . . . — • — — • —
K — • —	Inverted commas . . . . . • — • • — •
L • — • •	Underline . . . . . • • — — • —
M — —	Double dash . . . . . — • • • —
N — •	Distress Call . . . . . • • • — — — • • •
O — — —	Attention call to precede every transmission . . — • — • —
P • — — •	General inquiry call . . . . . — • — • — — • — •
Q — — • —	From (de) . . . . . — • • •
R • — •	Invitation to transmit (go ahead) . . . . . — • —
S • • •	Warning—high power . . . . . — — • • — —
T —	Question (please repeat after . . . . .)—interrupting long messages . . . . . • • — — • •
U • • —	Wait . . . . . • — • • •
V • • • —	Break (Bk.) (double dash) . . . . . — • • • —
W • — —	Understand . . . . . • • • — •
X — • • —	Error . . . . . • • • • • • • •
Y — • — —	Received (O. K.) . . . . . • — •
Z — — • •	Position report (to precede all position messages) . . . . . — • — •
Ä (German) • — • —	End of each message (cross) . . . . . • — • — •
Á or Å (Spanish-Scandinavian) • — — • —	Transmission finished (end of work) (conclusion of correspondence) . . . . . • • • — • —
CH (German-Spanish) — — — —	
É (French) • • — • •	
Ñ (Spanish) — — • — —	
Ö (German) — — — •	
Ü (German) • • — —	
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INTERNATIONAL RADIOTELEGRAPHIC CONVENTION

LIST OF ABBREVIATIONS TO BE USED IN RADIO COMMUNICATION

ABBREVIATION.	QUESTION.	ANSWER OR NOTICE.
PRB	Do you wish to communicate by means of the International Signal Code?	I wish to communicate by means of the International Signal Code.
QRA	What ship or coast station is that?	This is . . . . .
QRB	What is your distance?	My distance is . . . . .
QRC	What is your true bearing?	My true bearing is . . . . degrees.
QRD	Where are you bound for?	I am bound for . . . . .
QRF	Where are you bound from?	I am bound from . . . . .
QRG	What line do you belong to?	I belong to the . . . . . Line.
QRH	What is your wave length in meters?	My wave length is . . . . . meters.
QRJ	How many words have you to send?	I have . . . . . words to send.
QRK	How do you receive me?	I am receiving well.
QRL	Are you receiving badly? Shall I send 20 • • • — • for adjustment?	I am receiving badly. Please send 20. • • • — • for adjustment.
QRM	Are you being interfered with?	I am being interfered with.
QRN	Are the atmospherics strong?	Atmospherics are very strong.
QRO	Shall I increase power?	Increase power.
QRP	Shall I decrease power?	Decrease power.
QRQ	Shall I send faster?	Send faster.
QRS	Shall I send slower?	Send slower.
QRT	Shall I stop sending?	Stop sending.
QRU	Have you anything for me?	I have nothing for you.
QRV	Are you ready?	I am ready. All right now.
QRW	Are you busy?	I am busy (or: I am busy with . . . .). Please do not interfere.
QRX	Shall I stand by?	Stand by. I will call you when required.
QRY	When will be my turn?	Your turn will be No. . . . .
QRZ	Are my signals weak?	Your signals are weak.
QSA	Are my signals strong?	Your signals are strong.
QSB	Is my tone bad? Is my spark bad?	The tone is bad. The spark is bad.
QSC	Is my spacing bad?	Your spacing is bad.
QSD	What is your time?	My time is . . . . .
QSF	Is transmission to be in alternate order or in series?	Transmission will be in alternate order.
QSG	. . . . .	Transmission will be in series of 5 messages.
QSH	. . . . .	Transmission will be in series of 10 messages.
QSJ	What rate shall I collect for . . . . . ?	Collect . . . . .
QSK	Is the last radiogram canceled?	The last radiogram is canceled.
QSL	Did you get my receipt?	Please acknowledge.
QSM	What is your true course?	My true course is . . . . . degrees.
QSN	Are you in communication with land?	I am not in communication with land.
QSO	Are you in communication with any ship or station (or: with . . . . .)?	I am in communication with . . . . (through . . . . .).
QSP	Shall I inform . . . . . that you are calling him?	Inform . . . . . that I am calling him.
QSQ	Is . . . . . calling me?	You are being called by . . .
QSR	Will you forward the radiogram?	I will forward the radiogram.
QST	Have you received the general call?	General call to all stations.
QSU	Please call me when you have finished (or: at . . . . o'clock)?	Will call when I have finished.
QSV	Is public correspondence being handled?	Public correspondence is being handled. Please do not interfere.
QSW	Shall I increase my spark frequency?	Increase your spark frequency.
QSX	Shall I decrease my spark frequency?	Decrease your spark frequency.
QSY	Shall I send on a wave length of . . . . . meters?	Let us change to the wave length of . . . . . meters.
QSZ	. . . . .	Send each word twice. I have difficulty in receiving you.
QTA	. . . . .	Repeat the last radiogram.

*Public correspondence is any radio work, official or private, handled on commercial wave lengths.

When an abbreviation is followed by a mark of interrogation, it refers to the question indicated for that abbreviation.

These Code charts are supplied by the Department of Commerce, Washington, D. C. The new edition of "Radio Stations of the United States" can be obtained from the Superintendent of Documents, Washington, D. C.

QUESTION BOX

This department is for the sole benefit of the electrical experimenter. Questions will be answered here for the benefit of all, but only matter of sufficient interest will be published. Rules under which questions will be answered:

1. Only three questions can be submitted to be answered.
2. Only one side of sheet to be written on; matter must be typewritten or else written in ink, no penciled matter considered.
3. Sketches, diagrams, etc., must be on separate sheets. Questions addressed to this department cannot be answered by mail.

MAKE AND BREAK COIL OPERATION.

(368.) Montgomery Joseph, Cove, Tex., wants information regarding: (1) The operation of "make and break" coils for

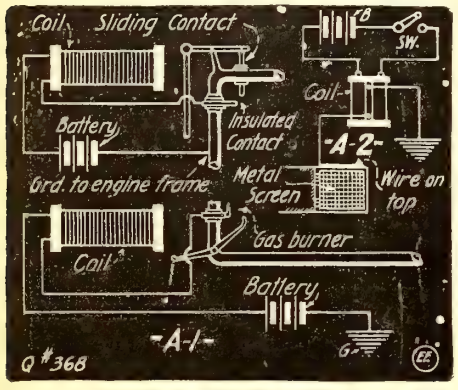


Fig. A-1. Hook-ups for "Wipe" Spark Gas Ignition Coils. Fig. A-2. Connection of "Jump" Spark Coil to Fence Gate.

ignition purposes, and (2) a method of protecting a gate or other entrance by using high-tension induction coils.

A. 1. The diagram given herewith shows how a "make and break" spark coil is used on gasoline engines or igniting gas burners, etc. It works on the principle of self-induced currents, which increases the battery potential at break of the circuit.

A. 2. You can protect a gate, as you mention, with a spark coil by simply hooking up proper switching arrangements operated in the house or by action of the gate itself, and this switch should be placed in the primary circuit of the coil as the diagram indicates. A pair of copper wires secured to the gate might carry the current from the secondary of the spark coil to give the shock, or one secondary lead may be grounded.

SODIUM VAPOR AND SPARK GAPS.

(369.) Francis Feig, Jr., New York City, asks: (1) How to obtain sodium vapor, and (2) the effect of lengthening the spark on the primary input to a spark coil.

A. 1. Sodium vapor is obtained from "Na" or sodium proper. The sodium is usually heated, and by proper appliances the vapor is gathered from same. The vaporizing point of sodium is about 95 deg. C. We have been unable to locate any definite data on the resistance of sodium vapor, and in this direction wish to suggest that you might communicate with Dr. A. N. Goldsmith, care of College of the City of New York, New York, who undoubtedly can supply data on this point.

A. 2. As the spark gap is reduced in length the primary will tend to draw more current. This is not so noticeable with an ordinary spark coil excited with dry batteries as becomes the case when a regular alternating current transformer is used, owing to the peculiar action resultant from the spring vibrator.

WAVE LENGTH AND ¼-KW. TRANSFORMER QUERIES.

(370.) Roy Trome, Norfolk, Va., desires to know: (1) Wave length of his aerial. (2) The dimensions and winding of ¼-kw. transformer.

A. 1. The wave length of your antenna, which is 50 feet long with a 49-foot lead-in, is approximately 175 meters. Should you use six wires on 18-foot spreaders your wave length will be increased to about 190 meters.

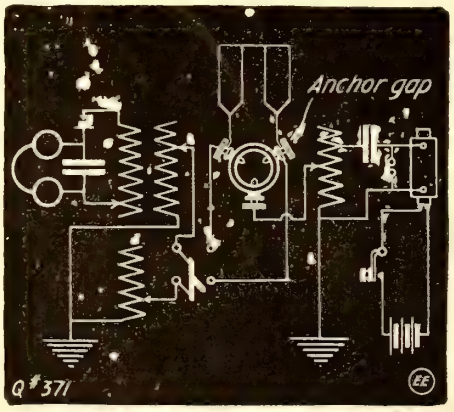
A. 2. The dimensions of the sheet-iron core for a ¼-kw. radio transformer are 10½ inches long and 6½ inches wide, outside measurements. The core should be 1.4 inches square. The primary should consist of six layers of No. 15 D. C. C. copper wire, and the secondary should comprise 3.7 pounds of D. C. C. copper wire wound into 17 pies, each ¼ inch thick. The secondary is wound with No. 34 wire and has 35,000 turns. Regular transformer practise should be followed in building this transformer, paying particular attention to the insulation of the different windings.

ANCHOR GAP HOOK-UP.

(371.) Carl Menzer, Lone Tree, Ia., wants information regarding the anchor gap in connection with a looped aerial.

A. 1. The anchor gap is practically not used any longer in modern wireless stations, as it entails too much loss in the transmitting set.

Diagram is given showing how the anchor gap is used with looped aerial, and in this way, as you will perceive, the spark can jump the gaps in transmitting, while in receiving this anchor gap reduces the complexity of the switching scheme necessary



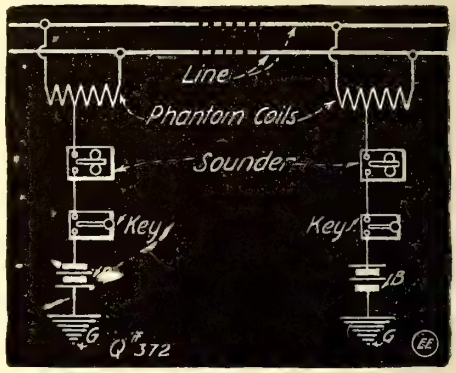
Arrangement of Anchor Spark Gap and Looped Aerial in Radio Transmitting and Receiving Set.

in throwing on and off transmitting and receiving set to the aerial.

PHANTOM CIRCUITS.

(372.) W. S. Clampitt, New Providence, Ia., inquires for a method by which he can transmit telegraph signals over a telephone circuit without interfering with the telephone transmission.

A. 1. We give herewith a sketch showing the method of accomplishing this by means of a "phantom circuit." It is necessary to construct two coils having a comparatively high impedance. These coils may be wound on a core of soft iron wire 6 inches long and ¾ inch in diameter, and



Use of Phantom Coils in Sending Telegraph Signals Over a Telephone Circuit.

consist of six layers of No. 26 S. C. C. wire. A tap should be taken from the third layer. The coils are then connected across the telephone circuit and the wire run from the taps on the third layer to the telegraph instruments; the other wire from the telegraph set is run to the ground in the usual manner, as shown.

AERIAL CONSTRUCTION.

(373.) Harry Slater, Brooklyn, N. Y., requires information on the usual method of erecting an aerial, particularly the manner in which the wires and spreaders are fastened together before hoisting to the tops of the poles.

A. 1. The usual way is to lay out the aerial wherever possible at full length on the roof or on the ground, and the two outside wires are the first ones to be secured to the insulators on the spreaders.

It is then an easy matter to connect up the other wires between the two outer ones, so that they will all be of approximately equal length and at equal tension when hoisted into position.

STATIC ELIMINATION.

(374.) Glenn Decker, Ligonier, Ind., asks us: (1) For a method of eliminating static in his wirelss receiving station. (2) Why the strength of the wireless signals from N.A.A. (Arlington) change.

A. 1. We do not have anything particular to suggest regarding the elimination of static in your wireless receiving station, excepting you try one of the static preventers, such as that devised by Professor Fessenden, and you will find complete hook-up for this arrangement given in our 25-cent book entitled "Wireless Hook-ups."

A. 2. The change in strength of the wireless signals from N.A.A. is, of course, experienced regularly, and this is due to the change in temperature, or from winter to summer; the winter range of radio stations is about two to three times that obtainable in summer. From some very

(*Continued on page* 432.)

EXPERIMENTERS READ EVERY LINE OF THIS INTERESTING AD-

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HERE IT IS AT LAST!

This 1-6 K. W. Closed Core Wireless Transformer.... $6.95



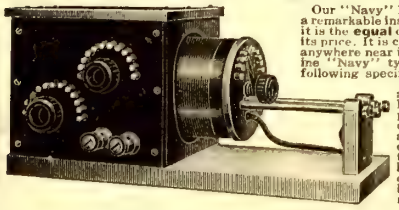
After months of experimenting and after making dozens of designs and models, we have finally produced a thoroughly practical closed core transformer to retail at $6.95, the price you formerly had to pay for spark coils and batteries.

Thousands of amateurs will welcome the advent of this instrument who either did not require ¼ K.W. power or who did not care to spend the money for it. The transformer will send messages for twenty miles not a wild figure, but an actual fact—if a good aerial is used. **Under extraordinary circumstances it will send** one hundred miles. No trouble with vibrators and adjustments, reactances or resistances. **Just connect the primary terminals to 110 volt, 60 cycle A.C. mains and press key.** Best silicon transformer iron is used in its construction.

It will throw a heavy crashing spark that, with proper condenser, will fill a gap with a ball of white flame ¼ inch in diameter. This comparatively small but powerful spark will send **six times as far as a 1 inch spark coil.** The 1-6 K. W. Transformer is another **ELECTRO-SET triumph.** It was thoroughly tested in one of the most complete electrical laboratories in the country by competent engineers, who pronounced it perfect, for its size, in all particulars. You will be delighted with it.

No. 1000 1-6 K. W. CLOSED CORE TRANSFORMER, without case, shipping weight 10 lbs. . . **$6.95**
No. 1001 1-6 K. W. CLOSED CORE TRANSFORMER, in a beautifully finished mahogany case; impregnated with insulating compound and fitted with four posts; shipping weight 15 lbs. . **9.00**

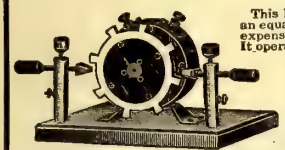
Electro-Set "Navy" Loose Coupler



Our "Navy" Loose Coupler or Receiving Transformer is a remarkable instrument. In price it is **lower** and in quality it is the **equal** of almost any loose coupler, no matter what its price. It is certainly far superior to any we have seen at anywhere near its price. Think of being able to buy a genuine "Navy" type loose coupler at a low price with the following specifications usually only found in prohibitively priced transformers: Hard rubber secondary end with large turned brass contacts; hard rubber switch panel on the front of the primary coil with twenty large, turned brass contacts; primary enclose i in a dark mahogany finished covering on all sides; every contact soldered, assuring perfect connection; handsome mahogany finished base; lacquered brass posts and trimmings. The equal of this receiving transformer can not be found. It is the acme of efficiency at moderate price.

NO. 1698 "NAVY" RECEIVING LOOSE COUPLER; shipping weight 10 lbs. **$10.00**
NO. 1698 "NAVY" RECEIVING COUPLER; all wood construction..... **9.00**

Type "A"



This Rotary Spark Gap is without an equal. Made like any of the more expensive gaps, but smaller in size. It operates in series with a 16 C. P. lamp on 110 volt alternating or direct current or from batteries. The Rotary Electrode is of cast aluminum alloy and is perfectly accurate. The wheel is mounted with genuine hard rubber on a heavy brass bushing which fastens to the motor shaft. The motor is a K. & D. series wound A. C. or D. C. Machine, small but **powerful.**

This Type "A" Gap, although especially designed for our extraordinary 1-6 K. W. transformer will readily stand any good ¼ K. W. instrument.

NO. 476 TYPE "A" ROTARY GAP, shipping weight 4 lbs. . . **$5.50**
NO. 477 TYPE "A" ROTARY GAP, wound to operate on 3 dry cells. **5.00**
NO. 478 THREE INCH ROTARY DISC ONLY, mounted on hard rubber, with brass bushing, ½ in. hole, shipping weight 4 oz. **1.50**

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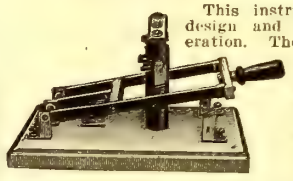
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Send 5c. in stamps for new, interesting catalogue of used Marconi Wireless Instruments at ridiculously low prices. We are agents for this line and can ship promptly anything from a Type "D" Tuner to a Motor Generator.

No. 611 Aerial Switch



This instrument is novel in design and convenient in operation. The base is dark mahogany finished. The copper bars are 8 inches long and are sawed, not drawn. Posts are provided on all contact jaws for connections. Three posts and bars are provided on one side for the purpose either of shunting the detectors when sending or cutting off the transmitting power when receiving.

This instrument is handsome in appearance and efficient in use. Suitable for powers up to 1 K.W.

NO. 611 AERIAL SWITCH, Shipping weight 5 lbs. **$2.50.**

Electro-Set "Arlington-Tested" Crystals

When testing out a wireless receiving installation for the first time you want to know that your mineral crystal is sensitive. Then, too, why buy minerals on a gamble. **Be sure of results—good results.** Buy our **"Arlington Tested"** Crystals. Every one is tested for Arlington time signals. Each crystal comes sealed in an air-tight glass phial and is carefully tested before leaving our factory. **Only one crystal in 20 passes our examination.** Arlington Tested Crystals are the most sensitive you can procure. They are worth the price. Each one is individually examined and packed.

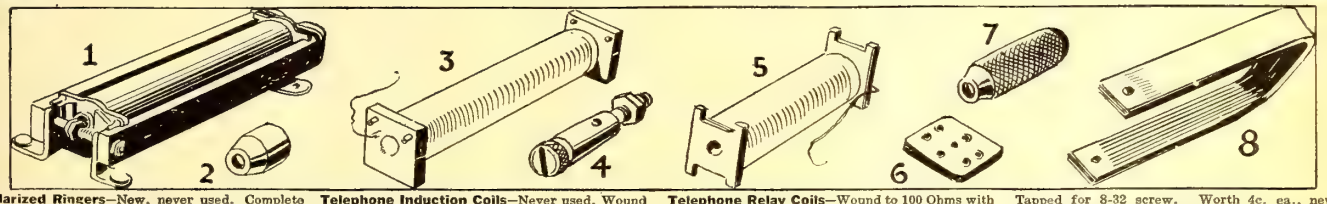
NO. 301 ARLINGTON TESTED GALENA, individually packed and tested; postpaid. . **$0.15**
NO. 302 ARLINGTON TESTED SILICON, as above. . . . . **.15**
NO. 303 ARLINGTON TESTED BORNITE-ZINCITE COUPLE. . . . . **.40**

Electro-Set "Famous" Mineral Sets

One of the most interesting fields in wireless telegraphy is the experimenting with various combinations and methods of contact in detectors. We offer the following outfit especially designed for this purpose and packed in a neat box. Countless hours of interesting experimenting is offered to the amateur with this set. It includes five different minerals (galena, silicon, carborundum, bornite and molybdenum), each packed in a neat glass bottle; one universal detector cup; three pieces phospor-bronze "cat whisker" wire; one polished wood detector base; one large binding post; one hard rubber knob; one brass rod with holder for wire. With this outfit it is possible to make many different kinds of detectors. It is ideal for the experimenter.

NO. 2100 DETECTOR MINERAL SET, as described, complete, postage paid. . . **$1.25**
NO. 2150 MINERALS ONLY, as above, five kinds, in bottles, postage paid. . . . . **.50**

14 EXTRA-ORDINARY BARGAINS



Polarized Ringers—New, never used. Complete with 2 high resistance magnet coils wound with silk wire and a strong permanent magnet with ringer. Worth 60c. ea. Any experimenter can use one. Special price, ea. **15c.** (Postage 6c.)

Hard Rubber Knobs—Size 19-16 in. x ½ in. Drilled and Tapped 1 for 6-32 screw. Handy for making apparatus. Worth 8c. ea., new. Special Price, per doz. **10c.** (Postage 3c.)

Telephone Induction Coils—Never used. Wound to 100 Ohms with primary and secondary coils, silk covered wire. Excellent shocking coil can be made with one. Worth 50c. ea. Special price ea. **09c.** (Postage 4c.)

Binding Posts—Handsomely nickeled, 5 16 in. x 1 in. over all. Complete with nut. Worth 6c. ea. Special price, per doz. **25c.** ea. **2½c.,** (Postage per doz. 5c.)

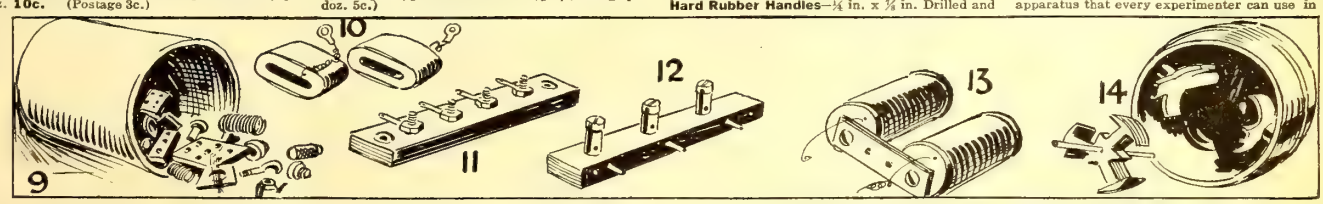
Telephone Relay Coils—Wound to 100 Ohms with size 36 silk covered wire. Complete with soft iron core. Wire alone worth 20c. Special price, ea. **09c.** (Postage 4c.)

Connecting Blocks—Hard rubber, size ¾ in. x 1 in. x 3-16 in. Have 6 holes for 6-32 mach. screws. Complete with 6 screws. Worth 12c. ea. Special price **04c.** (Postage 1c.)

Hard Rubber Handles—¼ in. x ¾ in. Drilled and Tapped for 8-32 screw. Worth 4c. ea., new. Special price, per doz. **15c.** (Postage 3c.)

Horse Shoe Magnet—3 in. long, very powerful—useful for many experiments and for making instruments. Worth 15c. each. Special price **05c.** (Postage 3c.)

Here's A Dandy Chance—We have made up a number of boxes of small odd parts of electrical apparatus that every experimenter can use in his shop. These boxes each contain from 40 to 60 pieces of odds and ends, such as rubber knobs, brass standards, hooks, binding posts, screws, units, thumb nuts, coils and miscellaneous parts. Some are new—some used, but all of them are useful to have around when you are making apparatus. They are just the kind of convenient parts to be able to choose from for your experiments. We've sold hundreds of them in our retail department. Experimenters all want them. You can make dozens of things with them.



No. 121—Handy Assortment. Prepaid **20c.**

75 Ohm Receiver Coils—Never used. Ready to put into any phone or to make receivers with. Wound to 75 ohms with silk wire. Worth 20c. pair. Special price, per pair, with connectors **06c.** (Postage 1c.)

Connecting Blocks—Made of genuine hard rubber, with 4 nuts and screws with connectors. Worth 15c. ea. Special price, ea. **05c.** (Postage 2c.)

Connecting Blocks—made of genuine hard rubber with 3 handsome nickeled binding posts. Useful for dozens of things about the experimenter's shop. Worth 25c. They have never been used. Special price, ea. **09c.** (Postage 2c.)

Relay or Telegraph Magnets—In fair condition. Have been used but are in perfect shape. Wound to 80 ohms resistance. Make relay or telegraph with them. Worth 50c. pair. Special price with yoke, per pair **09c.** (Postage 5c.)

Toy Motor Parts—Consisting of one iron case with pole pieces; 2 covers for same and one 3-pole laminated armature with shaft. All you need is a commutator, bearings, and wire to complete motor. Above parts worth 40c. set. Special price, **15c.** (Postage 6c.)

Note:—Commutator wire for above motor, extra **40c.** (Prepaid.)

THE ELECTRO-SET CO. 1874 EAST 6th ST., Dept. 110 CLEVELAND, OHIO

YOUR RANGE
DEPENDS ON YOUR
RECEIVERS





Holtzer-Cabot Radio Receivers

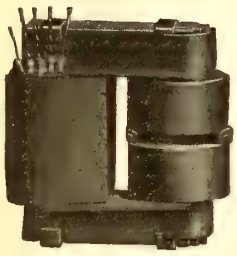
have honestly earned their reputation of being the

"Most Sensitive Receivers Made"

Other features are light weight, comfortable shape, durability, perfect finish. Send for Booklet 20 D2 for description.

THE HOLTZER-CABOT ELECTRIC CO.

BOSTON — CHICAGO



UNMOUNTED TRANSFORMER

You Can Get Results

with a small condenser and this transformer

It is a 1-2 K. W. size and is built on the same specifications as to material and workmanship, etc., as our big central station transformers.

Hundreds of stations are now using these transformers. This transformer gives you 13,200 volts.

Let us tell you how you can do part of the work yourself and get this transformer at a remarkably low cost.

THE PACKARD ELECTRIC CO.
555 Dana Avenue Warren, Ohio

BOSTON WIRELESS

Boston Receiving Transformer, $7.50
" Variable Condenser, 25 Plates, $2.75
Boston Detectors, $1.00, $1.25, $1.75, $2.25, $4.00

Agent for Electro Importing Co. and A. W. Bowman Co., Manhattan and Adams Morgan Spark Coils, Ever-ready flash lights and batteries.
Catalog for stamp only.

M. MUELLER, 18 Devonshire Street, BOSTON, Mass.

QUESTION BOX.

(*Continued from page 430.*)

exhaustive tests extending over a period of a year and more and presented in the Institute of Radio Engineers' "Proceedings" of a recent date, this summer range has been found for ordinary ship radio stations of the spark type to quite regularly be only equivalent to one-tenth the winter range.

REGARDING QUENCHED SPARK GAPS.

(375.) Frank Zacharia, Jr., N. S., Pittsburgh, Pa., desires to know how many pairs of gap plates are required for a ½-kw. and a 1-kw. wireless transformer.

A. 1. The number of pairs of plates required for the Telefunken gap depends upon the discharge voltage of your condensers. The general practise is to allow 1,000 volts to each gap. Thus, knowing the voltage of the transformer secondary or the discharge voltage of the condensers, it is very easy to calculate the number of gaps required. You understand that the more power there is used the larger the gap surface must be to prevent overheating of the gap.

ELECTRO-MAGNET DESIGN.

(376.) Charles Malcolm, Jr., Philadelphia, Pa., requires information: (1) As to relation between the size of a wire on a magnet and its lifting power. (2) Data for the construction of an electro-magnet to exert a force of one pound at a distance of 6 inches.

A. 1. It makes practically no difference what size of wire is found on an electro-magnet if the proper voltage is used in conjunction with same. That is to say, the same number of ampere turns will go in a given space, roughly speaking, if the voltage and current are properly balanced out, so that the coil will not overload. This, as you will perceive, is merely a matter of electrical design and calculation.

A. 2. Your problem for designing an electro-magnet to exert a force of one pound at a distance of 6 inches is rather out of the ordinary, and it would require a very powerful magnet coil to do this work. Possibly, however, your problem can be solved efficiently by the use of a properly designed solenoid or suction type electro-magnet. However, it does not seem practical to build a regular type electro-magnet to exert any such pull as you mention over the range of action specified.

INSULATION AND DETECTORS.

(377.) C. Russell, London, England, asks: (1) The best dielectric or insulator for high-frequency apparatus. (2) Several questions regarding the de Forest Audion and Fleming valve detectors.

A. 1. The best substance now available is that known as Bakelite Di-Electo. This is used by the Marconi Wireless Telegraph Co. for its panels on wireless receiving cabinets, and therefore can be considered as probably one of the best substances available at this time for the purpose in question.

A. 2. The Audion detector is supplied in America by the de Forest Radio Telephone & Telegraph Co., which manages practically all sales for this detector in this country, and it is, of course, supplied by various dealers. However, no independent companies make a detector similar to the Audion insofar as we are aware.

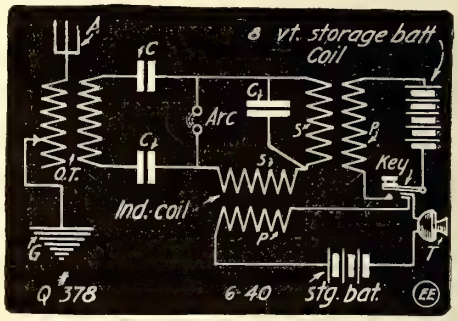
The Marconi Co. supplies the Fleming valve, but this is said on pretty good authority to be inferior to the Audion.

WIRELESS TELEPHONE QUESTIONS.

(378.) M. A. Norgren, Springfield, Mass., sends us a sketch of a wireless telephone transmitter and wishes to know: (1) If this set would work. (2) If not, why not? (3) Will the 6-volt 40-A.H. and 8-volt 80-A.H. storage cells be powerful enough, and how far will it work?

A. 1 and 2. To all appearances your apparatus will not work because you have the secondary of the 1-inch spark coil inserted in the high-frequency circuit, and the high impedance of this coil will prevent pure oscillations taking place.

A. 3. We cannot say whether the storage batteries you are using would be powerful enough for a wireless telephone, but an ideal set of this type should operate on such small storage batteries. We would like to say here that for a satisfactory wireless telephone it is necessary to obtain undamped oscillations in the closed oscillatory circuit having a frequency value of at least 30,000 per second, which is above audibility. It is impossible to obtain this frequency with an ordinary vibrator, and



Proposed, But Impractical, Radiophone Hook-Up.

for this reason spark coil sets have never worked satisfactorily over very long ranges and the enunciation in every case is very poor.

THE AURORA BOREALIS.

(379.) Lawrence Madison, Kingman, Me., writes us stating that he has personally seen the Aurora Borealis from his home in Maine and that a distinct hissing sound was noticeable. This is contrary to the statements in the article entitled "The Aurora Borealis, or Northern Lights," which appeared in the October issue of *The Electrical Experimenter*, and he wishes an explanation.

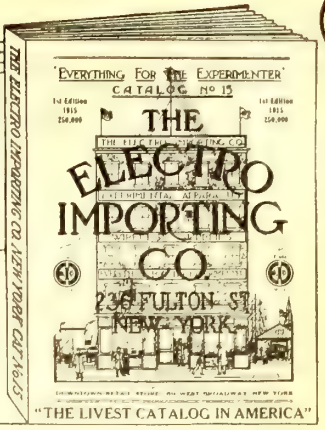
A. 1. It seems reasonable to suppose, and especially if we consider the Aurora Borealis an electrical phenomenon, that there may be a noise or sound produced by such a display. We have, however, checked up this matter quite carefully in preparing the article, and in all cases which came to our attention and wherever this sound theory or statement was made, it was invariably refuted by different authors and authorities on the Aurora Borealis. One of the best works on the subject is that by Alfred Angot, and while many statements are quoted therein from various people to the effect that they had distinctly heard sounds when the Aurora Borealis effect took place, the authorities on this matter give an explanation about in line with that mentioned in the article referred to.

This same idea, advocating the "no sound" theory with regard to the Aurora Borealis, is concurred in by Henri Arctowsky, a well-known authority on this phenomenon and a scientist who has passed many years exploring the Northern and Southern Polar regions. This does not, however, purport to infer that your ideas or statements are not correct, and, as yet, we can truthfully say that the Aurora

(*Continued on page 434.*)

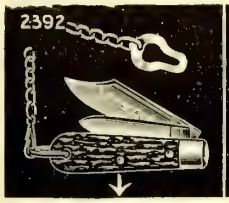


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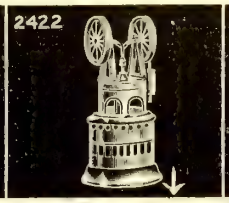


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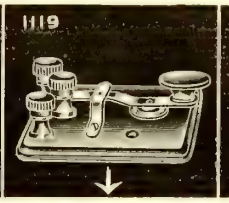
Boy Scout Knife. Has 2 excellent quality steel blades, stag handle and a chain to guard against loss. Chain is detachable at will. Length 3¾ in. Sh. wt. 4 ounces. Price ..... **$.50**



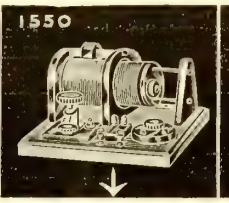
Upright Caloric Engine. Runs by hot air. Simplest model engine possible to construct. Is very durable. No steam or water used. Size 9½x4½. All cylinders of brass. Sh. wt. 2 lbs. Price ..... **$.95**



Smallest Flashlight Made. Nickel case, tungsten lamp, long life battery. Gives a very powerful light, is very handy and fits in vest pocket. Size 2⅝x1¼x11-16. Sh. wt. 4 ounces. Price ..... **$.50**



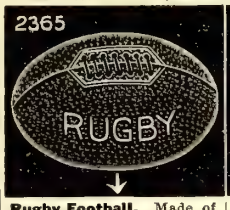
Telegraph Key. Double circuit. Rubber comp. base and knob. Has three rubber comp. binding posts. Metal parts nickeled. Size 2¼x3½. A wonderful value. Sh. wt. 1 pound. Price ..... **$.35**



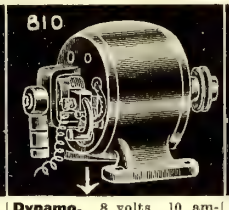
Inter-Ocean Wireless Receiving Outfit. Has loose coupler, galena detector, Jr. fixed condenser and 7000 meter loading coil all mounted and connected on polished oak base. Size 10x12x6½. Sh. wt 10 lbs. Price **$8.00**



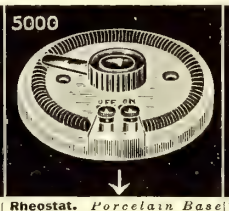
Wireless Detector. *Guaranteed to receive long distance messages or money back.* Base hard rubber comp. Metal parts nickeled, galena crystal supplied. Size 2x1½x1¼. *Our cyclopedia sent free with it.* Price prepaid ..... **$.10**



Rugby Football. Made of Pebble grain leather, lined with duck. *Bladder guaranteed against accident, wear or abuse for one year.* Most wonderful value ever offered. Standard size. Sh. wt. 2 lbs. **$.90**



Dynamo. 8 volts, 10 amperes. Very heavily built for auto. ltg., charging batteries, electroplating, etc. Excellent power motor on 8 volts, made to last. Size 8x5½x5¼. Sh. wt. 20 lbs. Price **$9.00**



Rheostat. *Porcelain Base* (Pat'd). Resistance 10 ohms, maximum capacity 3 amps. continually. Invaluable for dimming lamps, regulating small motors, etc. Diameter 4 inches. Controlled by 1" knob. Disconnects on off side. Binding posts rubber comp. Sh. wt. 2 lbs. Price ..... **$.60**



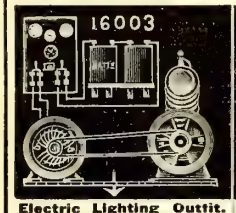
X-mas Tree Lighting Outfit. For 110 volt house current. Has 16 colored lamps, red, blue, white and green, arranged in two festoons. Absolutely safe and complete with cord and plug. Sh. wt. 3 lbs. Price **$4.05**



Hustler Motor. Runs wonderfully on one dry cell. Will operate small toys, beautifully finished and very strong. A wonder for the price. Size 3x3x4. Sh. wt. 1 pound. Price ..... **$.85**



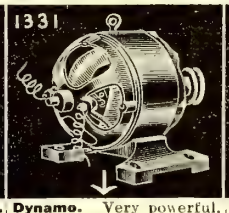
Revolver Flashlight. Exact model of automatic revolver, shoots brilliant light when trigger is pressed. Contains tungsten lamp and battery in handle. Surprise your friends. Size 4x2¾ ins. Sh. wt. 1 lb. Price **$.95**



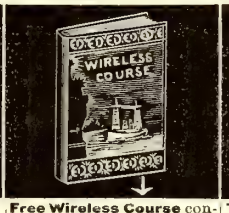
Electric Lighting Outfit. 8 volt 150 watt capacity. Includes generator, switch board with meters, etc., ¾ H. P. gasoline engine, storage battery, fuses, wire, belt, hydrometer and plans. Capacity 19 lights. Sh. wt. 185 lbs. Price **$74.00**



Radio Nitrogen Battery. *Gives 3 volts* and is same size as standard No. 6 dry cell. Wonderfully efficient. Made of extra high grade materials. Used for lanterns and experimental work. Size 6x 2½. Sh. wt. 3 lbs. Price **$.35**



Dynamo. Very powerful, gives 6 volts 6 amperes, lights, 12 tungsten lamps, charges storage cells, runs as a power motor, etc. *Not a toy.* Size 6x6x6 inches. Sh. wt. 7 pounds. Price **$3.70**



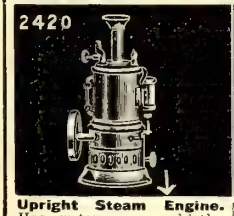
Free Wireless Course consisting of 20 lessons, total 160 page, cloth binder size 7x10¾ in. with 350 illus. 30 tables. *Coupons for this Free Wireless Course in our Cyclopedia Catalog.*



Telephone Receiver. 75 ohms. Hard rubber comp. powerful magnet. With two receivers and no battery, you can talk 500 feet. Size 2¼ x 1⅛ inches. Shipping weight 1 pound. Price ..... **$.40**



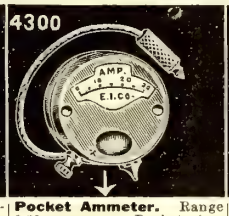
"Presto" Hand Lamp. Fits on any dry cell and will burn for 50-75 hours. No danger and always ready. Supplied complete without battery. Reflector is adjustable. Size 6x3. Sh. wt. 7 lbs. Price **$.75**



Upright Steam Engine. Has water gauge, whistle, large balance wheel and will operate on kerosene and petroleum. Tested before shipment. Directions included. 11 in. High. Sh. wt. 3 lbs. Price ..... **$.95**



Trolley Car Outfit. Wonderful value, will run on dry cells. Outfit consists of trolley car, controller, electric headlight and 15½ feet of straight and curved track. Car size 12x6x4. Sh. wt. 10 lbs. Price **$5.65**



Pocket Ammeter. Range 0-30 amperes. Pocket size. Finely nickel plated, accurate, dependable and handy. Invaluable for testing dry cells. Diameter 2¼ inches. Net weight 4½ oz. Sh. wt. 1 lb. Price ..... **$.80**



"Presto" Bicycle Lamp (electric). Operates almost *50 hours on one dry cell.* 2 inch reflector is fully adjustable. Fastens on handle bars. Battery container included but no battery. Perfectly safe. Sh. wt. 2 lbs. Price **$1.15**



Spark Coil. Gives 1 inch flaming spark on 6 volts. "Bull Dog" style that's copied but never equalled. Oak frame, platinum points. Rubber comp. binding posts. Size 7¾x5¾x6¼. Sh. wt. 6 lbs. Price **$4.00**



Printing Press (Self Inking). Will print a form of 2⅜x3¾ in. Includes 5a font, of 175 characters, type case, gold and silver bronze, ink, cotton, cards, etc., with instructions. Not a toy. Size 14x7¾x5½. Sh. wt. 25 lbs. Price **$3.00**

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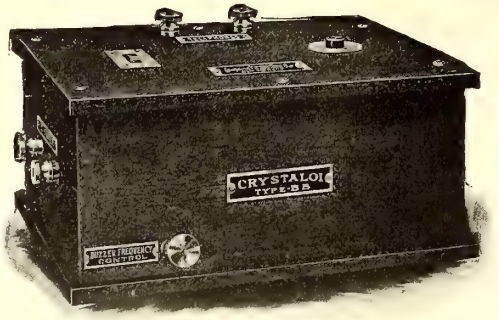
Write your name and address in the Margin below

CRYSTALOI
THE NEW–BB–

The New Type -BB- CRYSTALOI is a SUPERSENSITIVE Detector comprising every accessory and refinement in A SINGLE UNIT

It consists of a highly finished African mahogany case in which is located a super sensitive Crystaloi cylinder of which the periphery protrudes through the top making it accessible for rotating to secure finest adjustment. A cohering inductance especially calculated and calibrated to the supersensitive cylinder. A fixed condenser with the exact capacity for this particular cylinder. A specially wound Buzzer of which the frequency is controlled by a knurled screw head mounted on the front of the case to produce a note that is best suited to assist in cohering the alloy in the cylinder. Two of the highest grade dry batteries to operate the Buzzer and a Buzzer control button which protrudes through the top of the case for accessibility.

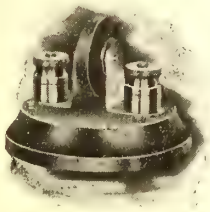
With this carefully designed and calibrated instrument you have but to set it on the table, connect your phones and leads from your tuning coil and you are permanently and thoroughly equipped to engage in the most serious wireless work of the present day. Of course Variable Condensers can be added if desired.



Dimensions 7½ x 5½ x 3½ high
Mailing Weight 3 Pounds. Price **$12.00**

— Other Types of the Crystaloi —

CRYSTALOI TYPE O
Very Sensitive



Dimensions 2¼ x 1⅞ in.
Mailing Weight 1 Pound.
PRICE, $3.50.

TWENTY-ONE HUNDRED MILES IS THE LATEST CRYSTALOI RECORD

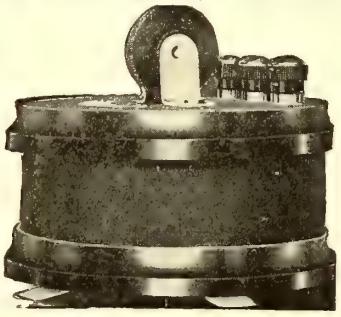
CRYSTALOI

A PERMANENT WIRELESS DETECTOR THAT HAS MADE A WONDERFUL RECORD

You will find wireless men on land and sea using Crystaloi Detectors in preference to any other detector made. They will not burn out or go dead and are ever ready to pick up the minutest currents that are in the air. They are sold under the Turney guarantee and are making their wonderful reputation on real merit. Send today for full description.

ORDER A CRYSTALOI TODAY AND STOP YOUR DETECTOR TROUBLES

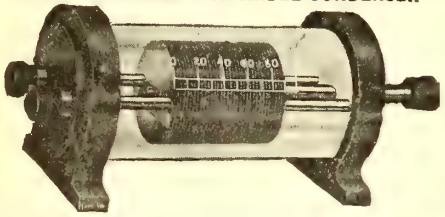
CRYSTALOI TYPE AA, Super Sensitive



Dimensions 4 x 3½ in.
Weight 2 Pounds. PRICE, $6.00.

OUR WIRELESS ACCESSORIES

THE NEW TURNEY VARIABLE CONDENSER



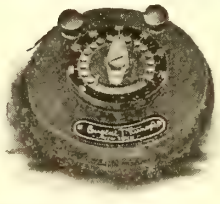
Dimensions: 5¼ x 2½ in. Made in two capacities.
Type X—35 Plates. Price $3.50.
Type XX—50 Plates. Price, $5.00.
ORDER ONE NOW
and see what you have been missing.

The New Turney Variable Condenser meets all the requirements of the most exacting wireless man inasmuch as it has more capacity for its size than any condenser ever made. The great advantage lies in the fact that it is provided with round plates of a special alloy 1½ in. in diameter, of which the entire area is available for condensing purposes. This you will find in no other variable condenser.

The New Turney Variable Condenser possesses an absolute zero. This you will find in no other type of condenser. The plates are inclosed in a flint glass tube on which the scale is engraved. It is air and dust-proof and can not get out of order. The dielectric is air, therefore the efficiency is the greatest possible. The ends are of hard rubber composition and are highly finished. A handsomer and more valuable wireless instrument you never saw.

SEND FIVE CENTS IN STAMPS FOR COMPLETE CATALOG

THE TURNEY ROTARY LOADING-COIL



Dimensions 3½ in. x 1 in.
Price $3.50.
Mailing Weight One Pound.

This is a radical departure from the accepted form of loading-coil for the reason that the entire coil with its switch points revolves while the switch blade remains stationary. This new form of construction makes a much neater and more compact instrument, and the rotating of the coil is a much more natural movement than turning the switch blade. It has a capacity of 4,000 meters divided into sixteen divisions of 250 meters each. When used with the ordinary loose-coupler will give a total capacity of about 4,600 meters. The entire instrument is of hard-rubber composition. The blade is of a silver alloy, which insures the maximum efficiency. The rotary coil has a knurled edge and is provided with a scale divided into sixteen equal divisions.

CONSTANT AMPLITUDE TEST BUZZER



CONSTANT AMPLITUDE TEST BUZZER
Dimensions 2¼ x 2½ ins.

Our special Constant Amplitude Test Buzzer contains some entirely new features and gives a smooth, even tone at all times. This is due to the arrangement of the contact which is provided with a lenient backcheck. The contact points are of pure silver, which prevents burning, and the entire mechanism is enclosed in a non-resonant dielectric case. PRICE, 75 CENTS

Include 10 Cents extra for postage. Remit in form of P. O. or Express Money Order.

Eugene T. Turney Company, Inc., 2595 Third Avenue NEW YORK CITY

QUESTION BOX.

(*Continued from page* 432.)

Borealis effect is really but very little understood, even by our foremost men of science.

DIMENSIONS OF ½-KW. STEP-DOWN TRANSFORMER.

(380.) John Burkitt, Madoc, Ont., Canada, asks us for the dimensions of a ½-kw. transformer to change 220 volts to 110 volts alternating current.

A. 1. The dimensions of the ½-kw. transformer for changing 220 volts to 110 volts are as follows: Core, outside dimensions, 14x7 inches and 1.4 inches square. Primary windings consist of 625 turns of No. 16 D. C. C. or enameled wire, and the secondary requires 312 turns of No. 13 wire. Three pounds of the No. 16 and 2½ pounds of the No. 13 will be sufficient for you to wind the transformer. It can be constructed in the usual manner and connected direct to the 220-volt mains. It will consume 2.5 amperes and will deliver 5 amperes at the secondary terminals. The iron core should be made of transformer iron and particular attention should be paid to the insulation.

OPERATION OF ROTARY GAPS.

(381.) Walter Franseen, Woodhull, Ill., desires to know: (1) If the "Multi-Audi-Fone" and the "Multum in Parvo" instruments are fully up to the claims made by the manufacturers. (2) Several points regarding the operation of a rotary spark gap.

A. 1. The "Multi-Audi-Fone" and the "Multum in Parvo" instruments are fully up to the advertiser's claims. *The Electrical Experimenter* does not carry any questionable advertisements in any sense of the word. We do not know the patent number on these instruments. However, you could, no doubt, find this out by communicating directly with the United States Patent Office, Washington, D. C., or with the manufacturers themselves.

A. 2. Your question regarding the rotary spark gap is not entirely clear, as most of the rotary gaps, to our knowledge, are of the one type. Perhaps you refer to a gap with two breaks; the number of breaks has little or no bearing on the matter, and the only effect obtained is an increase in the quenching effect. It is, of course, necessary to run the rotary gap so it sparks at the peak of each cycle of the A. C. for synchronism. This would give you 120 sparks per second on 60-cycle current. Non-synchronous gaps have been used with more or less success, particularly the Marconi type, which gives 240 sparks per second. To increase the tone of a spark gap, that is, to operate the disc at a higher speed, it is necessary to change the capacity of the condenser in the closed oscillating circuit for highest efficiency, the capacity being smaller the higher the spark frequency.

DOES A TUNER "KILL" SIGNALS?

(382.) "Experimenter," Georgetown, Tex., writes us inquiring how wireless signals pass through a tuner when the "curls" of the wire used in some electric connections have the effect of choking the signals, as we well know.

A. 1. A high frequency current flowing in a circuit similar to a circuit used in radio work requires that a certain amount of the inductance capacity should be in that circuit to prolong the oscillations, the turns of wire in the tuner acting as the inductance and the elevated aerial as the capacity. When these are properly adjusted the circuit is in tune and the incoming wave currents flowing in the circuit will be at their

maximum. Should any small coils be inserted in the connections it adds that much unnecessary inductance, which is of no use usually and the added impedance causes the current to be reduced in value, owing to the circuit being thrown out of tune, or to the increase in resistance (damping).

HYSTERESIS IN CONDENSER.

(383.) Jeter Pinkston, Valdosta, Ga., asks: (1) What is the standard formula for the solution in storage cells? (2) Is a high potential current a high voltage current? (3) What does hysteresis mean when used in the description of a variable condenser that is losing energy due to hysteresis? Also which is better to use in a variable condenser, oil or air?

A. 1. The standard solution used in storage cells is a mixture of 1 part of sulphuric acid to 5 parts of water. This should be mixed in an earthenware container and constantly stirred. Don't fill cells until solution has cooled.

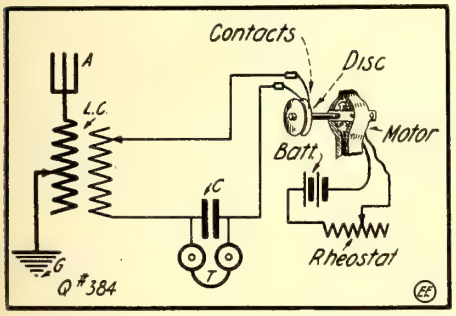
A. 2. A high potential current is one having a high voltage.

A. 3. Hysteresis loss here is the loss in the dielectric of the condenser. The plates of the condenser are constantly charging and discharging; thus the stress between them is constantly changing its direction. This change of stress has the effect of heating the dielectric and a small amount of the current is lost in this manner.

For high efficiency a variable condenser should use air as a dielectric, but oil increases the capacity and also the hysteresis loss somewhat, as mentioned in your question.

RADIO RECEIVING TIKKERS.

(384.) H. P. Keiffer, Lebanon, Pa.,



Undamped Wave "Tikker" Hook-Up.

asks: (1) Is it possible to receive stations using undamped waves with a Radioson, electrolytic, or mineral detector? (2) Can a copper disc be used in constructing a tikker and what is the location of the contact springs? (3) The hook-up for the tikker, using a loading inductance and tuning coil or loose coupler?

A. 1. It is only possible to receive undamped wave stations with an ordinary detector when the sending apparatus gets slightly out of tune, resulting in slightly damped waves. The tikker is necessary for all around work in the reception of undamped waves.

A. 2. Any metal can be used for constructing the disc of the tikker and the two springs can lay in the groove about one-half inch apart. The disc may be 2 inches in diameter, and a rheostat should be used to control the speed of the motor. The faster the motor is driven the higher pitched note will be as heard in the 'phones.

A. 3. Hook-up is given herewith for a tikker, and no detector is used in the circuit with this instrument ordinarily.

IS MÜNCHHAUSEN AT IT AGAIN?

(385.) R. E. Breunig, Chicago, Ill., asks several questions regarding a peculiar phenomenon that occurred in the neighborhood

(*Continued on page* 437.)

Multi-Audi-Fone

The new wonder in the wireless world. It increases the Audibility 1,500 Times

Read What Others Say

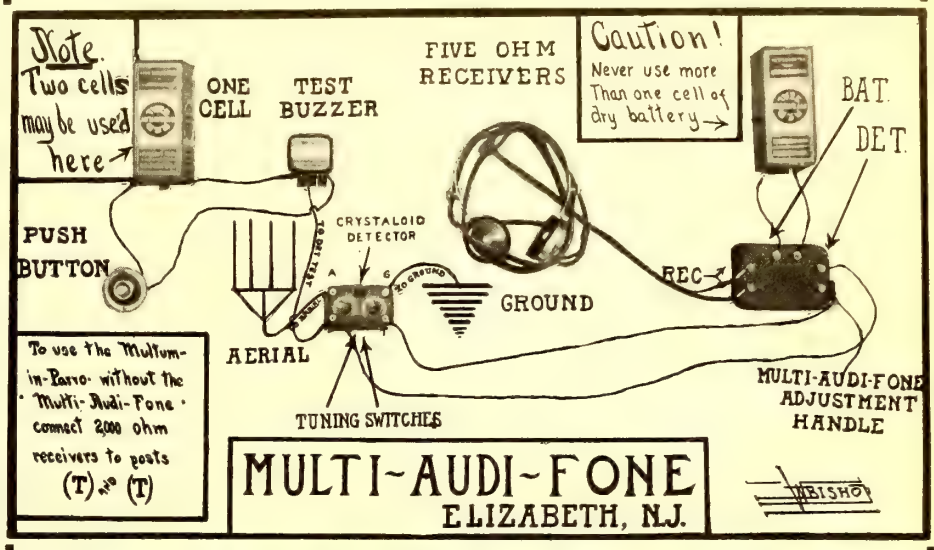
Messrs. Stickel & Stickel, of Connellsville, Pa., say: "We have given your apparatus a thorough test and find that they are all that you claim them to be."

Mr. D. L. Irvin, of Curwensville, Pa., says: "I was surprised with the results from it. Arlington and several other stations came in so loud that I could read them with the 'phones ten feet from my head."

Mr. Ralph Batcher, of Toledo, Iowa, says: "The results were even more than were expected, both at the convention and by other amateurs in Des Moines, who tested the apparatus, and other places."

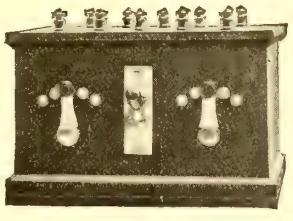
Mr. John Tucker, Jr., of Elizabeth, N. J., says: "After a thorough trial, am astonished at the results obtained . . . Combining, as these instruments do, the greatest degree of efficiency coupled with extreme compactness, they are, without doubt, the finest instruments offered to the amateur and professional wireless field at large."

W. O. Horner, of Cleveland, Tennessee, says: "I have been trying your Multi-Audi-Fone out as an Amplifier . . . I was more than surprised at its sensitiveness. It is certainly wonderful. . . . I stood at the rear of my store, one hundred and twenty-five feet from 'phones, and copied Arlington and Key West, also Tampa, Florida. I consider that some amplifying for way down here on Inland."



Multum in Parvo Receiver, including Crystaloi Detector and Buzzer - $20.00
Multi-Audi Fone, including our Specially Wound Head Set - - - - - $30.00
The Matchless Christmas Present. Our Complete Wireless Set, Only - - - $50.00

Talking Multi-Audi-Fone

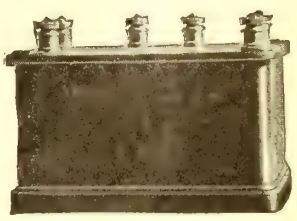


Size, 4½" x 5" x 7".

The amplification is so great with the Talking Multi-Audi-Fone that the signals can be read all over the five-story building from our laboratories, which are located on the third floor. If the windows are opened, the signals can be heard across the street, even when the trolley is passing.

Price, including horn - - $100

Telephone Voice Multiplier



Size, 2¼" x 3¼" x 4½".

The Telephone Voice Multiplier has been made possible by applying the principle employed in our Multi-Audi-Fone to the telephone receiver. The voice can be distinctly heard coming over 1,000 or even 2,000 miles of wire that would be indistinct coming over 100 miles of wire. Buy a Multiplier and stop straining to get something you can't hear. **Price $15.00**

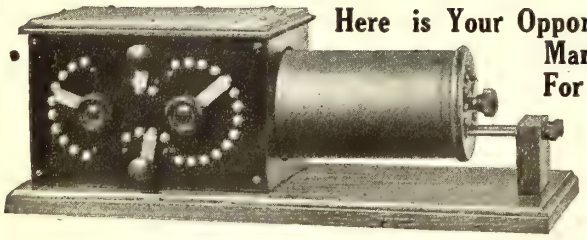
Send for circular to-day
Ask your dealer to-morrow
MULTI-AUDI-FONE
273 Morris Ave. ELIZABETH, N. J.

BUY NOW—SAVE MONEY

WIRELESS XMAS SALE

BARGAIN PRICES TO PROVE the wonderful values and superior goods we give you direct from our factory. These ridiculously low prices are only made possible by our enormous output for our tremendous trade. All highest quality—beautifully made and thoroughly tested out.

Save 25% If You Act Now



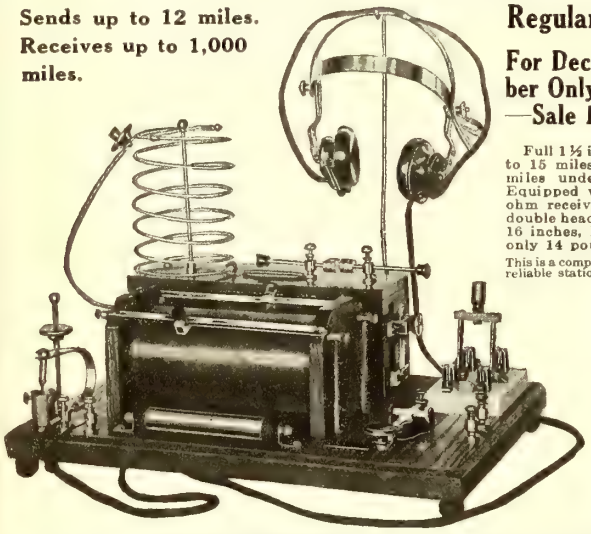
Here is Your Opportunity to Secure the Best Navy Type Loose Coupler on the Market. Regular Price - - - - - - $15.00
For December Only—Reduced Sale Price - - - $10.00

A brass lacquered 6,000 meter inductance tuner, perfect in every detail. Equipped with four point loading inductance which increases the wave length 4,000 meters over the average Navy Type Transformers. The primary winding has 24 taps—one switch controls the primary in groups of tens, the other controls one turn at a time—and is equipped with a dead end switch. Enclosed in a cabinet, the front of which is polished hard rubber. The secondary coil is wound with double silk covered wire and the inductance is varied by a ten point switch. With this coupler the very finest and most accurate tuning is easily and quickly secured. With a good sized aerial the reception of wave lengths up to 6,000 meters is possible.

All Finished Parts Ready For Assembling With Full Instructions - - - $6.50

Our No. 810 Complete Sending and Receiving Station

Sends up to 12 miles. Receives up to 1,000 miles.



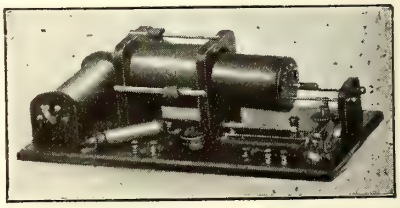
Regular Price $20.00
For December Only —Sale Price $14.00

Full 1½ inch coil type. Sends up to 15 miles. Receives up to 1,000 miles under favorable conditions. Equipped with 2 double pole 1,000 ohm receivers, 6 feet silk cord and double headband. Size of base 12 x 16 inches, height 13 inches, weight only 14 pounds.

This is a completely equipped and thoroughly reliable station, mechanically and electrically perfect and ready for instant service. Nothing better in the class was ever constructed. The new improved tuning coil enables you to tune in or tune out any party you might desire, thus eliminating any interference. The set consists of a 1½ in. Spark Coil, 12 Flat Plate Condensers, our "Don't Jar Out" Detector, Buzzer and Switch to tell if your detector is working, Double Slide Silk Wire Wound Tuner for long wave station capacity, Fixed Condenser, Helix, Key, DPDT Switch and complete 2,000 Ohm Headset.

Receive The Time From Arlington

AND ALL NEWSPAPER AND SHIP REPORTS
OUR SPECIAL TIME SIGNAL RECEIVING OUTFIT REGULAR PRICE $10.85—SALE PRICE $8.10



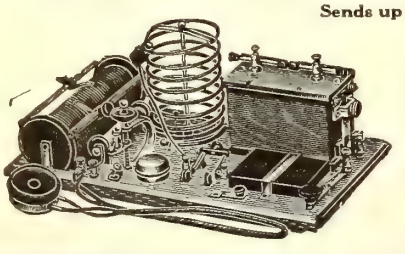
This is our new 1915 model made of the highest grade material obtainable. Double slide coupler for close tuning is wound with No. 24 green silk covered wire on the primary — the secondary with No. 28. There are 8 points to divide its capacity. A 3,000-metre loading coil placed between the coupler and the aerial by a switch that throws it in or out of the circuit enables you to receive amateurs with the coupler alone and long wave stations by the addition of the loading coil. One fixed condenser of proper capacity, improved universal detector, one buzzer test to test your mineral and potentiometer. This instrument is assembled on a highly finished oak base. All metal parts are heavy nickel-plated.

This station, with our Navy Type Loose Coupler, as illustrated above, ... **$15.00**

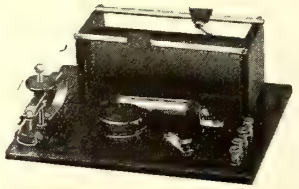
OUR No. 401 SENDING AND RECEIVING STATION

Regular Price $5.95
For December Only—Sale Price - - $4.95

Sends up to 3 miles. Receives up to 300 miles.



Consists of ¼-inch coil, fluted end spark gaps, four plate secondary, one collapsible helix, one key, a two-slide tuner, fixed condenser, detector and buzzer test to test your mineral. This set is mounted on a highly finished oak base with all metal parts heavy nickel-plated. With a good-sized aerial, under favorable conditions, will send up to 3 miles and receive up to 300 miles.



FREE!

Complete Gem Station

Receives up to 300 miles. We will give absolutely free a Gem Outfit to every one who sends us the cost of the necessary equipment for it. This equipment consists of:

2000 Ohm Headset	$3.95
16 Insulators	.48
1 Ground Clamp	.10
500 Ft. of A-1 Wire	1.20
20 Ft. of Rubber Cable for lead in	.90
TOTAL	$6.63

Send $6.63 at once and we will include the Gem Receiving Station Free. A splendid outfit for beginners.

Send 6c. in Stamps for Our Big 152 page Wireless and Electrical Catalog "H-80" Containing Hundreds of Wonderful Bargains of All Kinds FREE—Send for Big Electrical Toy Catalog. Save Money Xmas.

Nichols Elect. Co., 1-3 W. Broadway, N. Y.

Manufacturers of Standard Quality Goods Only

H-80

FREE—Write our QUERY DEPARTMENT. For free technical advice on all wireless questions send this coupon, with letter, to NICHOLS ELECTRIC CO., 1-3 West Broadway, New York.

QUESTION BOX.

(*Continued from page 435.*)

of Chicago from the 14th to the 18th of September last, when the wireless detector would go "dead" and no amount of adjusting would bring in any signals. He writes, however, that by reversing the connections to his detector it would be put into operation again. (2) When a rheostat or potentiometer is used to regulate the brightness of a lamp does the same amount of current flow from the battery whether the lamp burns bright or dim? (3) How does a Radioson work?

A. 1. We cannot think of any reason for the peculiar action of your detector, except that strong static currents may have been the cause; to the best of our knowledge *Baron Münchhausen* had nothing to do with it!

A. 2. As the resistance in the circuit determines the amount of current flowing through the circuit, increasing the resistance will decrease the current drawn from the battery.

A. 3. The Radioson detector is constructed on the principle of the sealed-point electrolytic device of this class. This detector at one time was thought to act on the drop of resistance principle, but later researches prove it to be a pure rectifier. See "Principles of Wireless Telegraphy," by Prof. George W. Pierce, where this matter is exhaustively treated upon, accompanied by actual rectifying oscillograms.

OPEN CORE TRANSFORMER ON D. C.

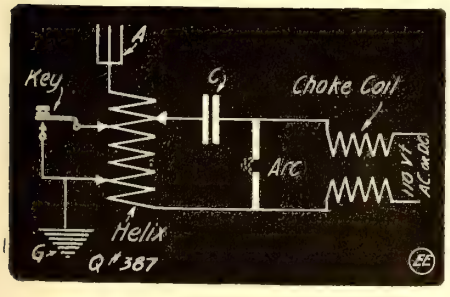
(386.) B. Tilden, Brookfield, Ill., writes us asking: (1) How an open core transformer can operate on D. C., having seen one working under these conditions. (2) Instructions for making a closed core transformer from a 2-inch coil.

A. 1. The fact that the transformer operated on a D. C. generator indicates that the commutator on the dynamo was in very poor condition, creating distinct breaks or bumps in the current. This would cause the transformer to operate the same as a spark coil on an interrupted primary current, but the efficiency is very low.

A. 2. A closed core transformer can be made from a 2-inch coil by constructing a rectangular frame of thin transformer iron and winding on one leg three layers of No. 16 D. C. C. copper wire and mounting the secondary of the 2-inch coil on the other leg. The input will be about 250 watts, and you should place a choke coil in series with the primary to control the current.

ARC TRANSMITTER FOR RADIO.

(387.) Edward D. Fitzpatrick, Wilson Park, Tarrytown, N. Y., requires (1) a

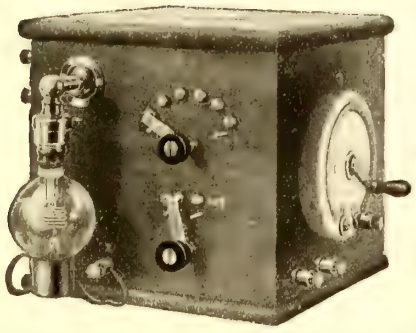


Are Used for Radiophony.

hook-up for transmitting set using an arc. (2) Why does the note of a sending station become louder when the rotary gap has stopped and while the last few letters are being sent?

A. 1. The sketch herewith shows the

The Famous
DE FOREST AUDION



Type R. J5 De Forest Audion Detector

The Bulletin of the U. S. Bureau of Standards, Vol. 6, No. 4, Page 540, states that the DE FOREST AUDION DETECTOR is fully 50 per cent. MORE SENSITIVE than ANY other known form of detector.

NO HIGHER AUTHORITY could be quoted.

Further than this—ASK ANY USER.

The cut illustrates the popular and efficient Type RJ5 De Forest Audion Detector. It remains in adjustment ALWAYS, and is guaranteed to be MORE EFFICIENT, and MORE RELIABLE than ANY OTHER detector ever offered for private use. **Price, $25.**

THE DE FOREST AUDION AMPLIFIER is used in connection with any detector, preferably a De Forest Audion Detector, to increase the intensity of received signals from 5 to 10 times (actual, not theoretical) per step. Constant and reliable, as all other De Forest Audion Apparatus. Brings in stations otherwise inaudible, ALWAYS. **Price, $65,** and worth it.



Type PJ1 De Forest Audion Amplifier

WARNING

Vacuum Bulbs, having a filament and two electrodes, as well as a number of other types, are protected under a large number of BASIC PATENTS, issued to Dr. Lee de Forest, and owned or controlled by this company.

All infringers will be prosecuted to the full extent of the law.

DE FOREST AUDION APPARATUS is sold by all the large reliable wireless supply houses and is carried in stock by most of them.

ORDER FROM YOUR REGULAR DEALER, or from us if you prefer.

Bulletins giving complete descriptions sent if you enclose stamp

De Forest Radio Telephone & Telegraph Co.

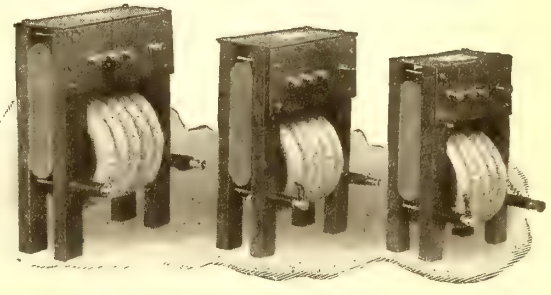
101 Park Avenue, New York, N. Y.

Winger's Closed Core Transformers

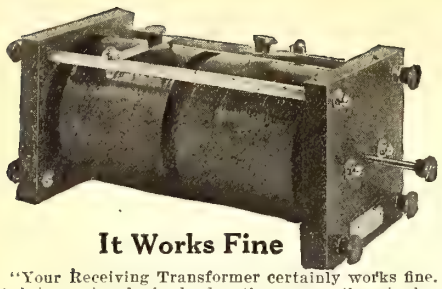
14,000 VOLTS
Perfectly Insulated.

¼ K.W.	$10.75
½ K.W.	15.00
¾ K.W.	20.50
1 K.W.	25.50

Designed for direct connection, 110 volts 60 cycles without resistance or impedance. Send 6c. for big new catalog.



Winger Elec. & Mfg. Co.
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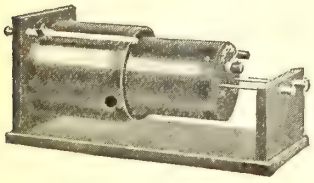


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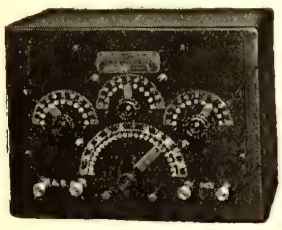
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method of wiring an arc for radio transmitting purposes. With this apparatus you will be able to cover quite a long distance, but it will be necessary to use a tikker or audion "beat" circuit at the receiving station.

A. 2. The only reason we can give to explain why the note from a transmitting station increases in intensity when the rotary gap stops is as follows: The diaphragm in the receiver has a certain natural period of vibration, and this may be approximately tuned to the low frequency of the note when the rotary gap is stopped. Your receiver diaphragm does not vibrate fast enough to be in synchronism with the group frequency of the transmitting set when the gap is running, therefore it does not give the loud note noticed when the two are nearly at the same pitch.

MAGNETIZING COILS.

(388.) Young Experimenter, Buffalo, N. Y., wishes to know: (1) Where he can obtain a battery type magnetizer of the Swedish-American type? (2) If distilled water can be used instead of rain water in mixing solution for silver plating, and if rain water is a chemical or naturally pure solution?

A. 1. You can no doubt purchase a battery type magnetizer of the Swedish-American type from the Swedish-American Telephone Co., located in Chicago, Ill.

A. 2. Rain water is condensed moisture from the atmosphere and contains no alkali, but has several impurities in it, such as dust and traces of various acids found in the air. Distilled water can be used in mixing plating solutions instead of rain water, as they are both practically pure, but not chemically pure.

PERPETUAL MOTION.

(389.) George Haller, St. Louis, Mo., asks us: (1) Has any perpetual motion machine ever been invented that will deliver power? (2) How do aeroplanes obtain a "ground" for wireless work?

A. 1. No one has succeeded in inventing a practical perpetual motion machine as yet, and such an invention would entirely upset all our present basic laws of physics and energy.

A. 2. Aeroplanes obtain a ground by dropping a wire 100 or 200 feet long from a reel, and they use wires strung from the tail to the wing-tips for an aerial.

WAVE LENGTH OF COUPLER.

(390.) Nels Erlandson, Chicago, Ill., desires: (1) A formula to calculate the wave length of loose coupler. (2) A tuning coil. (3) Whether a carborundum detector requires a battery potentiometer.

A. 1 and 2. A rough method of determining the wave length of coupler or tuning coil is to calculate the length of the wire on the coil, primary only, in the case of the coupler, and multiply the length of this wire in feet by 1.5, which will give approximately the wave length in meters. For further data on this we refer you to the September, 1914, issue of *The Electrical Experimenter*, in which appeared an article entitled "Loose Couplers and Their Wave Lengths"; also to the numerous publications procurable at small cost from the Bureau of Standards, Washington, D. C., which give exact mathematical formulas for calculating self and mutual inductances of coils of various sizes and diameters of wire used in radio practise.

A. 3. For the best results with carborundum detectors a critical adjustment of the voltage applied to it is required and it will be necessary to use a potentiometer with battery for this purpose.

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are ideal for use by electrical experimenters. The Fibre case lights have a patented wireless feature which absolutely prevents their short-circuiting under any conditions whatsoever. The nickel plated lights won't short-circuit, either, and are not affected by oil or moisture.

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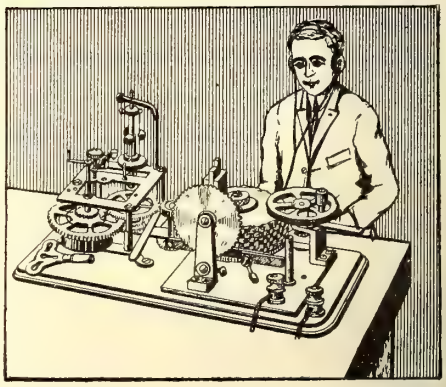


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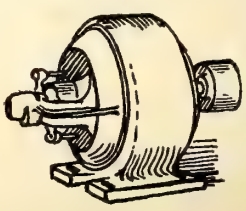
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MAGNETIC PULL.

(391.) Verne Bonnett, Birmingham, Iowa, desires a formula for calculating the pull of a magnet at various distances from its poles.

A. The pull of a magnet varies inversely as the distance of the armature from the poles; thus, if a certain magnet will lift 20 pounds 1 inch from the pole-pieces, then 2 inches from the pole-pieces it will lift one-quarter of this amount, or 5 pounds, and if 3 inches, one-ninth of this amount or about 2.2 pounds. This law is known as the rule of inverse squares and is also applicable to lighting problems as well.

ELECTRIC WIRING QUESTIONS.

(392.) John Odill, Norway, Mich., asks several questions regarding the wiring of a house: (1) Is a person allowed to do additional wiring on his premises without permission from the authorities? (2) Where can he obtain this permission, if necessary? (3) Must the work be inspected before connecting to the service line?

A. 1 and 2. It is unnecessary to obtain permission to install additional wiring in the house and barn, but proper precautions must be taken in this work, so it will comply with the Fire Underwriters' rules.

A. 3. It is necessary that the wiring should be inspected by the Fire Underwriters' before connecting to the supply mains, or the fire insurance policy on the building will be void should it burn down from any cause.

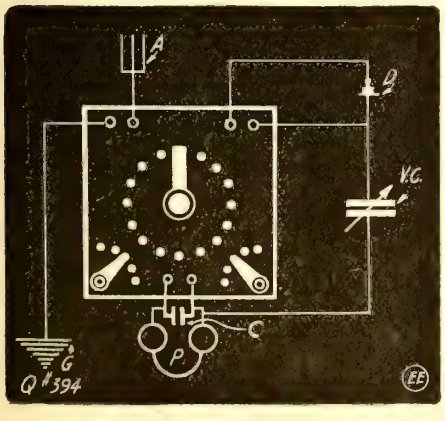
MOTOR TROUBLES.

(393.) R. O. Shadd, Williamstown, Pa., writes regarding his 1-6 H. P. motor which sparks on the positive brush when the current is turned on, but ceases to spark when the motor reaches its maximum speed.

A. The above mentioned action may possibly be explained by the fact that the positive brush is not at the right angle of commutation and the armature, drawing more current when accelerating, will make the sparking more noticeable than when running under normal speed conditions, with the armature current somewhat lower. Another cause for this may be that one of the wires in the armature is grounded, causing an excess flow of current. When the motor reaches full speed centrifugal force might throw the wire away from the armature, thereby destroying the ground.

RADIO CONNECTIONS.

(394.) Henry E. Davies, Jr., Vineyard Haven, Mass., writes us asking for a hook-up for the Mignon cabinet style radio receiving coupler, together with variable condenser.



Hook-Up for Mignon Radio Cabinet Receptor.

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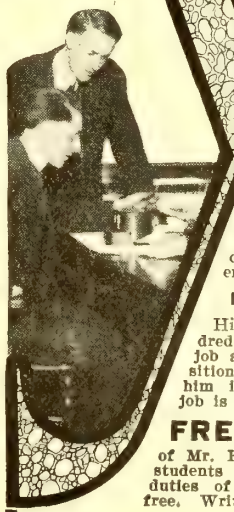
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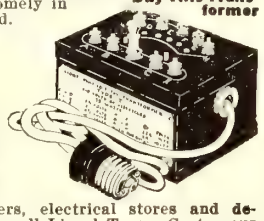
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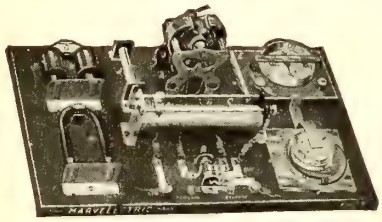
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THE RADIO PIONEERS.

In a recent communication to the *New York Times* Dr. Alfred N. Goldsmith, director of the radio laboratory at the College of the City of New York, said:

"I have read the highly interesting reports which have appeared in the *Times* describing the radio (wireless) telephonic experiments carried on over great distances by the American Telephone & Telegraph Co., using for the transmitting station one belonging to the United States navy (Arlington, Va.). Without desiring to disparage in the least the undoubtedly earnest and intelligent engineering work which has resulted in the accomplishment of this particular achievement, I feel strongly that less than due credit has been given to the many and eminent radio engineers who have done previous research work in this field, and without whose work the results just obtained would have been completely unattainable.

"I have been creditably informed that what are known as oscillating gas valves have been used for generating and controlling the power used in this work. While I cannot hope to gauge the relative importance of the contributions of all the previous inventors, I certainly believe that the following gentlemen are entitled to much more than a curt dismissal of their claims, and ignoring of all they have contributed to our knowledge of the oscillating gas valves. I refer to Edwin Armstrong, of Columbia University; Dr. Lee De Forest (under some of whose patents the American Telephone & Telegraph Co. is already licensed); Professor Fleming, of London University (one of the early workers in this field); Peter Cooper Hewitt, Dr. Irving Langmuir, of the General Electric Co.; Dr. Meissner, of the Telefunken Co.; Professor George Pierce, of Harvard University; H. J. Round, of the English Marconi Co.; Dr. Reisz and his associate, von Lieben, of the Telefunken Co., and Mr. Weagant, of the American Marconi Co. Three of these gentlemen, Messrs. De Forest, Armstrong and Langmuir, have in the order named made the results of their researches public in the 'Proceedings of the Institute of Radio Engineers,' and the interesting and important information which they gave has thus become available.

"It is impossible for me to apportion credit for the present achievement suitably among all the gentlemen mentioned, but it is quite certain that their united contributions to radio telephony have made the Arlington-Hawaii transmission possible. It is their due to receive credit for what they have done. It is not just that the commercial organizations involved should receive full public credit and the originating engineers be hidden by enforced anonymity. It is certainly to be hoped and expected that they will receive at least the mention which they have earned."

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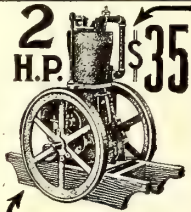


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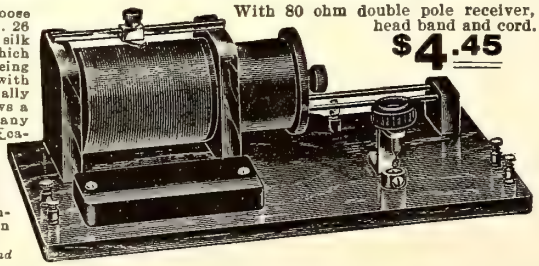
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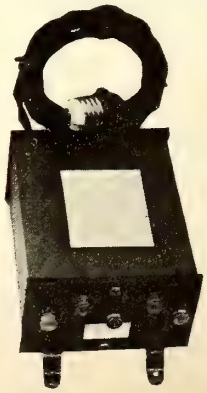


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PATENT ADVICE

Edited by H. GERNSBACK

In this Department we will publish such matter as is of interest to inventors and particularly to those who are in doubt as to certain Patent Phases. Questions addressed to "Patent Advice" cannot be answered by mail. Sketches and descriptions must be clear and explicit. Only one side of sheet should be written on.

FOOLPROOF ELECTRIC SWITCH.

(33.) Wilmer J. Slifer, Quakertown, Pa., submits a sketch of a novel electric switch which he terms "foolproof" for the reason that it is necessary to use a key in connection with it. He wants to know if this switch can be patented, and if such an article is in demand.

A. After looking over the drawing and the description, we have come to the conclusion that a patent could not be obtained on this device, at least, we have our doubts about it. In case a patent was actually obtained, we do not think it would be of very much value as switches of this kind are not very well liked by the trade.

ELECTRIC RAIN AND WIND SIGNAL.

(34.) Martin Hoeft, Minonk, Ill., claims to have a new device for electric rain and wind signals, but fails to submit drawings to explain the idea. In the absence of these we cannot give any advice on the merit of the invention.

INSULATOR AND AERIAL CONNECTOR.

(35.) Bernard Russell, Colorado Springs, Colo., has sent in a drawing of a new insulator on which he desires to have some advice. He also submits an aerial connector and wants to know if the latter is patentable. He inquires further if there is a market for these two articles. He furthermore wishes to know if an article can be patented by using Electrose instead of porcelain for insulation without the consent of the company.

A. The insulator presents no novel ideas and we do not think it is practical; we doubt whether a patent could be obtained on it.

The connector, however, has some very novel features, and this is an article that probably will be welcomed by many wireless people. You should by all means try to obtain a patent on this connector, and we think this can be done without much trouble.

Concerning the last inquiry, you cannot obtain a patent by simply changing one material to another. In other words, if you constructed (let us assume) a screwdriver made of aluminum, you could not obtain a patent on this screw-driver simply because it was made of aluminum. The mere substitution of materials does not entitle anyone to a patent.

TEMPORARY WIRING INSULATOR.

(36.) Walter Franseen, Woodhull, Ill., has submitted to us a new idea showing how to run temporary wiring on walls which have been papered, by using a special appliance. He wishes to know if the idea is good enough to warrant obtaining a patent on it, and whether the idea has any merit.

A. Inasmuch as no sample had been submitted to this department, we are not quite sure that the device will do everything which our correspondent claims for it. As far as we can see, the idea is novel and we think a patent might be obtained upon it, but we would advise our correspondent to be cautious and he should try to have a search made in the Patent Office before going ahead with the patent. This is the best we can suggest in the absence of the actual model.

SELENIUM WIRELESS RELAY—ELECTRIC REGISTERING THERMOMETER.

(37.) Isaiah Rosin, Cincinnati, Ohio, submits to us a drawing of a selenium wireless relay which is supposed to work by means of a selenium cell and a telephone receiver and by its vibrating diaphragm and amplifying relaying arrangement. He wishes to know if a patent can be obtained upon this device. He also has bruitted an idea on a registering thermometer which is intended to be used in registering temperatures at a distance. He wishes to know if this device is novel and whether it can be patented.

A. We find that the first idea is entirely impractical and it will not work the way it has been submitted to us. A relay does not work on alternating current and the idea of lighting a lamp as outlined in the drawing to operate a second selenium cell is not practical and will not work.

As to the electric registering thermometer, this is quite a clever idea and deserves being looked into. We think that if this device were to be worked out carefully from its present crude state a valuable patent might be obtained upon it. We would advise our correspondent to get in touch with a patent attorney.

ROTARY SPARK GAP.

(38.) William Boyle, Brooklyn, N. Y., submits a drawing of a new rotary spark gap in which two separate motors are used and the spark points being arranged in a novel manner.

A. While the idea of using two motors on a rotary spark gap is not novel, the arrangement of the spark points seems to have some merit, at least we have never seen anything quite like it.

We think the best way is to get in touch with some of the patent attorneys and have a search made in the Patent Office to find out what has been done before in this line. If you find that nothing similar exists so far, you stand a good chance of obtaining a patent.

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BARON MÜNCHHAUSEN'S NEW SCIENTIFIC ADVENTURES.

(*Continued from page* 388.)

have been in Flitternix's mind too, for presently he set his chronometer to noon, which, of course, was a ridiculous thing to do, for we did not know if the Martians divided their day into 24 hours or into 100 hours.

"We were now floating some 1,500 feet up over what we afterward knew to be the Martian National Capital, the 'city' of the Ruler. It is located in the elliptical spot which terrestrial astronomers have marked as *'Solis Lacus'* on their Martian maps.*

"As if our host had divined our innermost wishes, we soon passed over the capital and approached the waterway which you will find in your Martian map under the name of *'Nectar.'*

"The Martian Canals! At last we beheld one of them at a distance of less than 2,000 feet! The riddle of terrestrial astronomers for over a century! The cause of one of the most heated controversies on Earth! And now we saw them close by with our own eyes!

"The 'Canal' proper, which is termed 'Nectar' by astronomers on Earth, is about 6 miles wide. It runs in a perfectly straight line for over 500 miles and is about 20 feet deep. Like all other Martian waterways, it is lined with the Universal Martian material termed TOS, which looks like glass, yet is not glass. The Tos in this instance is waterproof, is an electrical conductor on one side and an insulator on the other. Yet it is a solid body and much harder and tougher than steel. The conducting side is turned toward the water, and when a certain current of ION is sent through the Tos, the water near it loses all weight because the gravitational attraction of Mars is neutralized thereby. It becomes now an easy matter to move the tremendous masses of water, a problem which your earthly scientists could never solve.

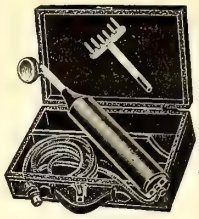
"At each bank of the vast waterway we saw immense towers about 2,000 feet high. These towers are spaced about 5 miles apart and follow the entire course of every canal. Their purpose is as follows:

"At the top of each tower is an immense 'pyramid,' made of a certain variety of Tos. The sides of these pyramids are formed of thousands of small black cells, which, when exposed to the Sun's rays,

* See accompanying map of Mars. Solis Lacus is located at about 30° latitude and 90° longitude. Nectar runs from the eastern (left) edge of Solis Lacus, due east.

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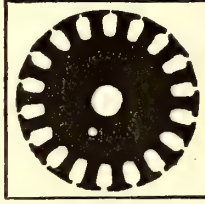


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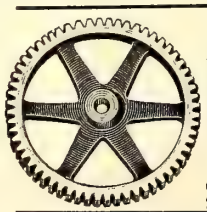


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absorb the heat of the latter. As the surface of these pyramids is very large, a proportionally large amount of heat is received. This heat is directly transformed into ION and stored within the pyramid. The latter turns on its axis, so as to present the largest possible surface to the Sun from sunrise until sunset; also as more power is generated than needed during the daytime the excess is used during the night.

"Now, then, from the top of the pyramid a gigantic Emanation Ray bursts forth, fed from the stored ION, originally secured from the Sun's heat.

"This ray is made to fall over the entire width of the waterway, and it is directed on the latter at an angle. The ray striking the water, which does not resist, as it has no weight, as explained to you, must naturally move away from the direction of the ray. This it does, the Emanation Ray 'pushing' the water at a rate of about 2¼ miles an hour. If it was not for the ray the water would, of course, be entirely motionless, for the Martian waterways are exactly level, there being no 'fall' to them.

"As each tower assists in moving the water over a certain distance the water gradually acquires momentum and flows slowly but steadily. Before the momentum has been expended, the next tower is reached, which pushes the water on to the next one, and so on through the entire length of the Canal. You will naturally understand that these towers must work nights as well as during the day, else the water would not flow during the night. The stored surplus power during the day, of course, makes this possible. Furthermore, the towers work to their full efficiency and uninterruptedly year in and year out, for there are no clouds to hide the Sun on Mars, as it is well known; consequently, the pyramids are never without power, except nights.

"You realize that all the towers must throw their rays in the same direction, which, of course, they do; thus, if the water is to be moved in one season from North to South, the rays face the South. During the next season when the flow of the water must needs be reversed, as explained to you yesterday, the Emanation Rays will all point northward. Thus one of the great problems on Mars has been solved. But who does the work? The all dominating Sun.

"And who moves the waters on Earth? Who condenses the waters from the oceans and lifts up myriads of tons of water year in and year out, to form clouds, which latter produce the rains, without which your rivers would run dry within four weeks? The

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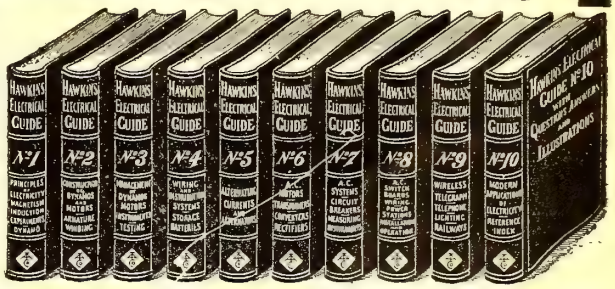
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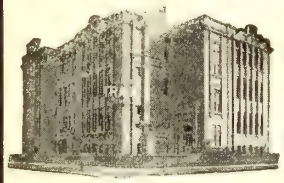
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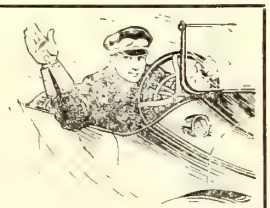
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(To be continued.)

SUBMARINE F-BOATS ALL UNSAFE, NAVAL BOARD FINDS

The preliminary investigation into the cause of the sinking of the submarine F-4 on March 25 last at the entrance of Honolulu Harbor has resulted in a report to the Navy Department, which asserts that all four of the submarines of the F class, including the F-4, had inherent faults, and were difficult to keep in repair and that serious trouble was experienced with their propelling engines, electric motors and storage batteries; in short, that they were in a dangerous condition for use on long dives like the one on which the F-4 met with the accident which wiped out the lives of her officers and crew.

The Board of Inquiry found that the storage batteries of the F-4 were always in a state of being more or less electrically "grounded," due to leakage of electrolyte, and that these "grounds" have been of sufficient intensity to cause flame and the fusing of electrical connections, also that these faults obtained in all four of the boats of the F class, of which there are three remaining, the F-1, F-2 and F-3. The F-4's storage batteries evolved excessive quantities of hydrogen gas. The fumes of hydrogen and acid were noticeable inside the F-4 on long dives and on March 6 last, some days before the F-4 was lost, there was a hydrogen explosion in that submarine which damaged the battery deck and broke several separators of the cells. The report just received by the Navy Department asserts that the "conditions under which an explosion of hydrogen is always possible obtain in all the boats of the F class."

RADIO LINKS TWO PRESIDENTS.

It was announced at the Navy Department recently that congratulatory messages were exchanged between the President of the United States and the President of Guatemala in celebration of the opening of a new high-power radio station erected in Guatemala City, Guatemala.

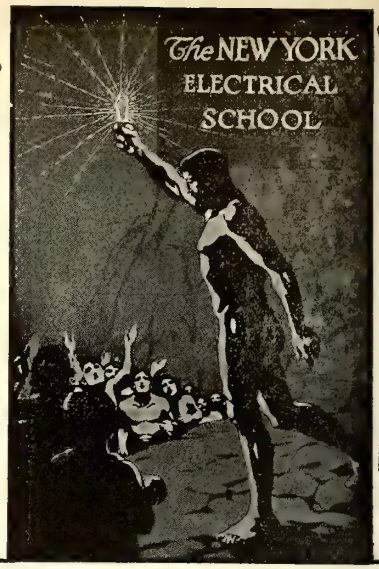
The naval station at Arlington, Va., handled the American messages.

NEW ELECTRIC AIR WARMERS.

The approach of cool weather is directing attention to the subject of convenient electrical means for warming rooms. To the variety of these equipments now available there has been added recently a new line of electric portable and fireplace heaters, which is made by a Western manufacturer.

A complete assortment of these is on display in the Manufacturers' Building at the Panama-Pacific International Exposition.

These heaters are all of unique construction, with one or more heating units. The one shown in Fig. 1 resembles an enlarged desk telephone stand, and has one heating unit consuming 615 watts. It is made of brass, highly nickeled. The height of the outfit is 16 inches, and the base is 6.5 inches in diameter. The weight is about five



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pounds, making this a very handy device that can be readily placed where desired. The reflector behind the heating unit directs the heat to the point where it is needed.

The heater, or rather stove, shown at Fig. 2, will take the place of a small coal or oil stove, and it stands 28 inches in height. It weighs 13 pounds and has two heating units which consume 960 watts.

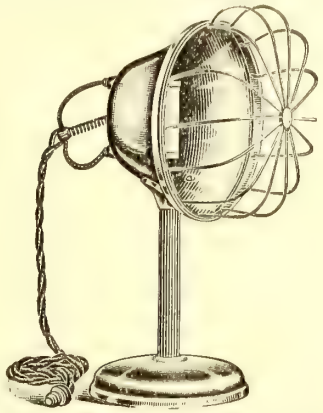


Fig. 1. Small Size Electric Heater of New Type.

Body and guard are finished in white or black enamel, the balance of the heater being highly nickeled.

This form of heater will give a great deal more satisfaction to the user than any electric heater yet placed on the market, say the builders. High efficiency is obtained by operating the heating units at a high temperature, thus increasing the resistance and decreasing the operating cost. They can produce heat comparing with other radiators at approximately 20 per cent. lower amperage.

They do not depend solely on the wire temperature for radiation, and the high temperature surrounding the unit is not affected by outside atmospheric conditions as readily as the comparative low temperature produced by other heaters; in other words, it is a more permanent heat.

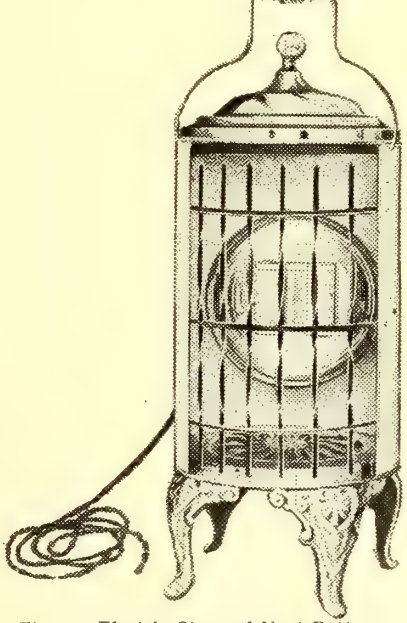
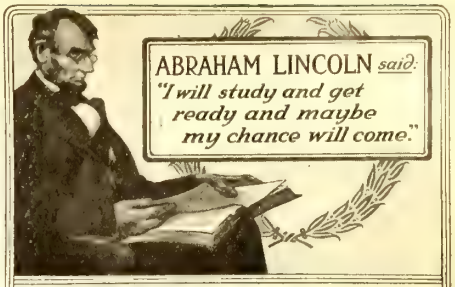


Fig. 2. Electric Stove of Neat Pattern. Consumes 900 Watts.

Superior durability for the heating unit is claimed and from the thermal point of view in regard to durability, the individual parts of the units are being operated on an average of 30 per cent. below fusing point, and this allows for any condition arising which may cause trouble in case of an excessive voltage.



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TO BREAK FOGS BY ELECTRICAL WAVES.

Shipping men in New York are interested in an announcement from San Francisco that experiments are to be made there in an effort to dispel fog by the use of electrical waves. The problem of clearing such inland waters as New York Harbor from the dense mists that often interfere with navigation has engaged the attention of experts for many years, but no scheme within reasonable cost has yet been brought forward.

Recently oil has been suggested. The Hydrographic Office of the navy is tentatively considering this subject.

The news from San Francisco is to the effect that Government scientists have constructed a giant electrical machine with which experiments are to be carried on in the harbor. The machine is a giant electrical transformer, the largest one ever built. It can take a current of 1,000 kilowatts at 2,300 volts and "step" it up to 1,000,000 volts. This charge is expected to produce a broad, continuous flash of lightning 100 feet long. Experts believe the result of this electrical disturbance will be to clear up a fog or mist for some distance; that is, in comparatively inclosed waters. The experiments will be watched with great interest by steamship men and navy officers.

Peter Cooper Hewitt, a recognized expert in matters electrical, in expressing his views as to the efficacy of this method, said: "I have not gone into the question, so I am unable to properly discuss it, but I see nothing improbable in its efficiency. It might work in small inclosed spaces and under proper conditions. As I recollect, somewhat similar experiments were conducted several years ago on the Thames at London to clear the deck spaces of the fogs. The results were said to be of a satisfactory character, but what has been done since then, if there has been any continuance of the work, I am not informed."

BOOK REVIEWS.

ALTERNATING-CURRENT ELECTRICITY AND ITS APPLICATION TO INDUSTRY. (First Course.) By W. H. Timbie and H. H. Higbee. Cloth covers; 534 pages; 5¼x8 inches; 370 illustrations. Price, $2.00. Published by John Wiley & Sons, N. Y. City.

This book is planned to meet the requirements for a work, simple enough to be readily understood by the beginners, yet sufficiently advanced to form a basis for engineering calculations and practical A. C. work.

Power transmission, fundamental ideas of A. C. currents, different arrangements of circuits, power factors, reactance and construction of single and polyphase generators, are among the subjects covered.

The text is well illustrated with many clear analogies and photos of actual apparatus. The subject is covered in a rather broad manner to give the reader a clear grasp on alternating current theory and practise, while the authors promise another course, soon to be ready, which will cover the subject more in detail, as to the characteristics and operation of commercial types of machines and appliances.

APPLIED ELECTRO-CHEMISTRY AND WELDING. By Charles F. Burgess, E.E., and George W. Cravens. Cloth covers; 140 pages; 135 illustrations; 5¾x8½ inches. Published by American Technical Society, Chicago, 1915. Price, $1.50.

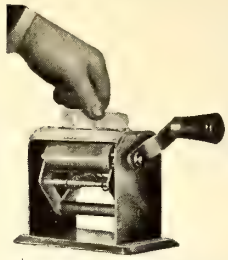
A practical treatise, written in a clear, readable style, that is sure to increase the interest in practical applications of electrolysis and welding.

The first part covers the subject of electrolysis, electro-plating, decomposition, high tension generation of ozone and the method of nitrogen fixation in an impressive and non-technical manner.

The remainder treats of electric welding in all its forms. The various application of electrical, gas and chemical welding, are discussed at length. This book is worthy of perusal by every worker in the above-mentioned field, who will find his time well repaid by such reading.

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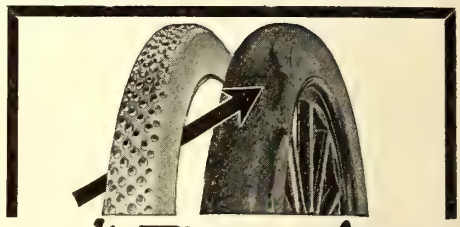


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Murdock, B.Sc., and U. A. Aschwald, B.A. Cloth covers; 5¼x7½ inches; 366 pages; 164 illustrations. Published by Macmillan Co., New York City. Price, $2.75.

In this work the writers have endeavored to create a work suitable for the advanced "meterman" and have succeeded admirably.

In the historical summary, they show early forms of measuring instruments and then take up each type, going on to explain carefully and at length with many formulæ, the theory, as well as the practical details of each instrument up to and including various forms of demand supply meters.

Closing with chapters on magnetic permeability meters and a discussion of the post office box and slide wire bridges, the chapters form a well balanced and symmetrical whole. This book will no doubt find a place with all specialists on meter work, desiring to keep in touch with the best practise.

ELECTRICAL MEASUREMENTS AND METER TESTING. By David P. Moreton, B.S., E.E. Cloth covers; 4½x6¾ inches; 266 pages; 191 illustrations. Published by Frederick J. Drake & Co., Chicago. Price, $1.00.

In this work the author has succeeded in combining great clearness with conciseness and accuracy. The fundamentals are handled in a manner not surpassed by his treatment of higher and more technical alternating current measurements. Many analogies, combined with profuse illustrations, tend to make the work invaluable, alike to the layman and practical electrician in search of knowledge on the subject of electrical measurements.

Starting with the idea of giving the reader a good grasp on the principles of electricity, the author carries him forward in short steps to a full knowledge of all methods of measuring electricity, making in all, a book worthy of a position in every electrician's bookcase.

ELECTRICITY FOR THE FARM. By Frederick Irving Anderson. Cloth covers; 5¼x7½; 266 pages; 50 illustrations. Published by Macmillan Co. Price, $1.25.

Taking a really difficult subject, the author has treated it in an exceptionally clear manner. Starting off more like fiction than a technical treatise, he shows the great changes on the farm made possible by a small electric plant. He proceeds with an elaborate treatment of water-wheel installations, leading up to the electrical equipment, which is treated at some length.

The final chapters deal with gas engine and wind power as applied to electric generators. With this book at hand, the farmer can start to install an electric plant with full confidence of success.

HOW TO PASS U. S. GOVERNMENT WIRELESS LICENSE EXAMINATIONS. By E. E. Bucher; 70 pages; 37 illustrations; size, 9x5¾ inches; paper bound. Price, 50 cents. Published by Marconi Publishing Corporation, New York City.

This book, arranged in the form of a catechism, fills a long-felt need. Answering as it does 118 questions of actual bearing on the subject, it is an invaluable help to the radio amateur who desires to pass the U. S. Government wireless license examinations.

The questions are answered in a clear, easily understood, manner not untouched with a certain amount of technical terms. The book treats of the different parts of a radio installation in order and covers each quite thoroughly.

It gives numerous formulas for the calculation of the various currents and apparatus. The book appears to have been written in a very hurried manner as the errata is rather large, and in fact it contains a minor mistake in itself. However, this book should find a large demand with students of radio phenomena who desire a better grasp on the subject in a practical way.

YEAR BOOK OF WIRELESS TELEGRAPHY AND TELEPHONY FOR 1915. Published by Marconi Publishing Corporation, New York City. Size, 8½x6 inches; 1,000 pages; 32 illustrations; cloth bound. Price, $1.50.

The year book for 1915 has just made its appearance and it surpasses the 1914 edition both in size and quality of its contents. It contains as usual the complete list of ship and land stations of the world and the laws and regulations of the various countries on radio-communication.

It also contains numerous formulas and tables invaluable to the commercial operator as well as to the amateur and deserves a position on every experimenter's book-shelf.

The chapter on wireless telephony is very brief and treats of the various systems in a general way, going into few details. However, it treats of the entire history of wireless telegraphy in some detail, as to discoveries of the various experimenters in this line, etc.

The various articles by prominent men in the field of radio-communication are of special interest and timely. They deal with the effects of wireless telegraphy on the present European conflict and

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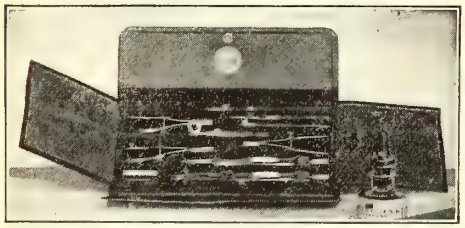
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the latest developments in long-distance wireless communication. The adaptation of wireless telegraphy to meteorology and surveying are treated on in an interesting manner

The book likewise contains lists of radio societies. wireless telegraph companies, the latest books and periodicals available on the subject, a glossary and dictionary of technical terms, etc.

Presenting in one volume the entire history of wireless telegraphy as well as the latest advances in the art it fulfils its mission as a year book in a satisfactory manner.

THE WIRELESS TELEGRAPHIST'S POCKET BOOK by Dr. J. A. Fleming. Red leather covers, gilt edges, 348 pages; 39 illustrations; 4½x7½ inches. Published by the Wireless Press, London, England, 1915. Price $1.50.

This is a much desired pocket size volume of extreme value to the radio operator and engineer, whether for theoretical or practical consideration. The author is one of the best known writers and scientists in the wireless field, and has here presented a general clean-up on the necessary measurements and calculations occurring in wireless telegraph and telephone engineering. Sufficient diagrams and illustrations are incorporated to make the book of great practical value.

The section covering the different losses and over-all dimensions as well as the efficiency of the individual apparatus making up a complete wireless transmitting set, is of extreme value and has not been covered heretofore in most text-books, which presume to deal thoroughly with the subject. Some of the subjects covered include a considerable amount of mathematics up to Calculus, and this section ends with electrical and other units, dimensions, etc. This is followed by chapters on high frequency and voltage measurements; capacity calculations and absolute measurements by the bridge method; frequency and cymometer measurements; aerial and etheric wave radiation, covering the calculation and determination of radiation resistance and decrement; transmission and transmitting circuits, as well as receiving circuits, with a final section covering routine station practise for radio operators. The book contains an appendix of valuable mathematical tables, including logarithms, circle dimensions, etc.

All in all, this neat volume appears to possess great merit and it should find a ready sale among all radio men who wish to have at their fingers end the latest concise data on this important branch of science.

There are several sections of the book which seem as though they might have been made larger, even if other sections had to be cut down somewhat. This pertains particularly to the opening chapters, which deal with mathematics. Manifestly it is impossible to cover the subject of mathematics in a few pages, and while to many users of this handbook the mathematical notes will be found useful, it would be just as well to have left them out or made them cover less ground, as those who are interested sufficiently can procure numerous treatises at a nominal cost, covering mathematics very thoroughly and completely.

BY WIRELESS PHONE FROM ARLINGTON TO PARIS.

(*Continued from page* 393.)

Paris and also in Honolulu.

"We have now heard from all our expeditions, and it is interesting to note that the circle of the area covered by these expeditions was about 10,000 miles in diameter. Never in history was such an expedition ever undertaken as was this one."

"How long was it before Webb in Arlington was able to establish communication with Shreeve in Paris, and what test words were used?" Mr. Carty was asked.

"Owing to the very limited time at their disposal, it was necessary to cable the exact minute during which the Eiffel Tower plant was available," he replied, "and in those few seconds Webb did his talking. Signals had been previously arranged, first by numbers, and then followed by words. Shreeve was to cable what he got after each test—that is, provided he got anything—and, as you know, the signals were heard on three different nights. Owing to the fact that there is now in existence only one set of transmitting instruments, and that at Arlington, the talk, of necessity, as was the case with San Diego, Honolulu and the other places reached by the expedition, had to be one-sided."

[*Editor's Note.*—For details and illustrations of apparatus used at Arlington in Honolulu talk, see November, 1915, issue of *The Electrical Experimenter.*]

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HIGH FREQUENCY CURRENTS AND APPARATA.

(*Continued from page* 405.)

experiments with high frequency currents will be found described in the series of many excellent books listed at the end of this discourse. It can also be said that we of to-day know very little about these high frequency currents and their possibilities. Nikola Tesla has done more in this direction than any other person, as can be readily judged from the fact that over 15 years ago he successfully produced sparks 100 feet long resembling in volume and sound the lightning discharges we have all seen in nature (not imitation ones). It is hoped that this article may serve to kindle the spirit of research along these lines in the young experimenter's mind, and he surely will be amply rewarded for any discoveries he may make in this little-understood branch of electrical science, which bids fair to unlock the door to a future electrical era of which our generation has no reasonable conception at this time.

BIBLIOGRAPHY.

Books Recommended.

The Theory and Design of Induction Coils. By H. Armagnat.

High Frequency Currents (Electro-therapeutical). By Dr. Frederick Finch Strong.

Experiments with Alternating Currents of High Potential and Frequency. By Nikola Tesla.

Electricity at High Pressures and Frequencies. By Henry L. Transtrom.

Wireless Telegraphy and High Frequency Electricity. By Prof. H. LaV. Twining.

Wireless Telegraphy. (Covers Tesla's wireless transmission of power patents.) By Charles Henry Sewall.

Articles Published in Back Numbers of Electrical Experimenter.

A ¼-kw. Tesla Coil. Page 73, September, 1913.

Currents of Utra-High Frequency and Potential. Page 151, February, 1914.

A Tesla Transformer for One-Inch Spark Coils. Page 187, April, 1914.

Electro-therapeutics and High Frequency Apparatus. Pages 20-23, June, 1914.

Some Experiments with High Frequency Currents (in two parts). Page 24, June, 1914; page 119, December, 1914.

High Frequency Currents—Explanation and Apparatus (in two parts). Page 68, September, 1914; page 84, October, 1914.

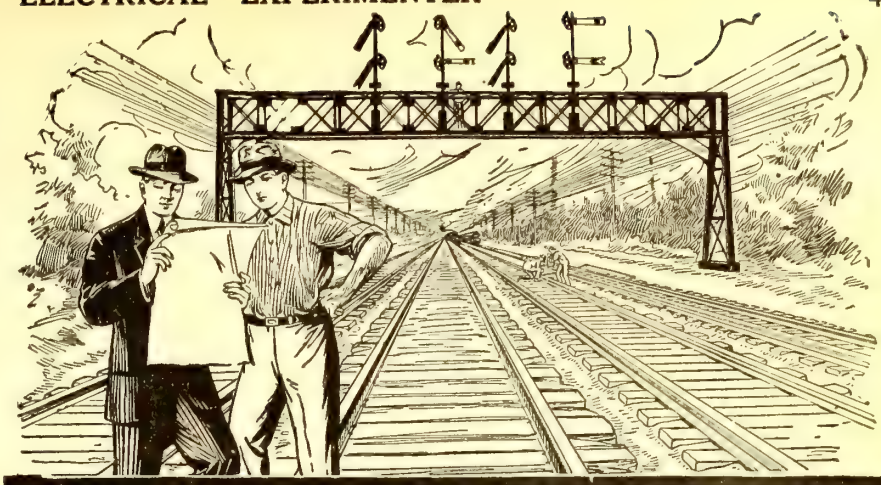
A Miniature High Frequency Outfit. (Construction details given.) Page 123, December, 1914.

Spectacular Discharges and Large Tesla Coils (36-inch spark apparatus. Construction details given). Pages 54-55, June, 1915.

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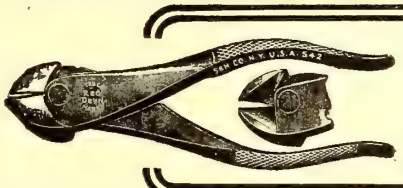
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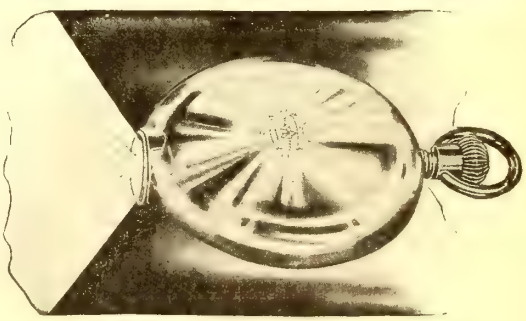
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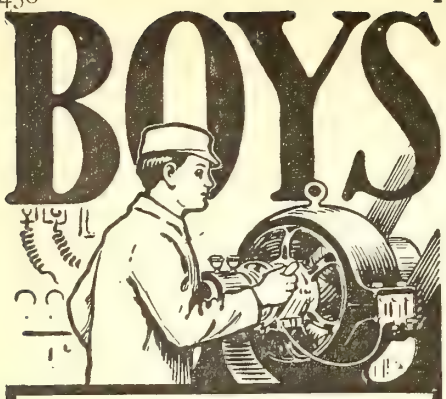
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TO FOIL SUBMARINES WITH UNDERSEA SEARCHLIGHTS.

(*Continued from page* 392.)

this end the inventors make use of an observation tube. This can be any of the well-known devices for seeing beneath the surface, but they prefer the *mariscope,* shown at 16, arranged adjacent to the tube 10 and being curved at right angles 17 and 18 at top and bottom. A lens 19 is provided at the lower extremity of the tube, and opposite this is an inclined mirror 20, with another above, 21, at the upper end of the tube; from this the rays are refracted to the sight hole 22, at the end of the tube 17, so that when any object appears in the *illuminated field* its image, or at least a shadow of it, will be caught by the mariscope and seen in the sight opening 22.

As soon as they had devised a means of locating an object in the path of a vessel to be destroyed the inventors next foresaw the necessity for having some means at hand of attaining this end. They devised, therefore, a torpedo tube 23 at the bow of the vessel and adjacent to the means for locating the object. Our illustration herewith shows a torpedo being discharged. The inventors would have it understood, however, that their invention does not lie in any detail of the torpedo tube or of its location, but that any means of discharging a torpedo or other missile from the bow or from the submerged part of a vessel can be employed in connection with their means of *locating the object* to be destroyed and their invention of an electrical device for *exploding a discharged torpedo* when it hits or reaches the vicinity of the object to be destroyed.

As illustrated, the torpedo 24 has connecting wires 25 with any usual or preferred sparking device, wound into a cable 26, which is carried on a reel 27. The terminals 29 on board the vessel are connected by means of two wires with a source of supply of electricity provided with a controlling key 30. When it is seen that the torpedo is in the immediate vicinity of the submarine, mine or other object it can be immediately exploded by closing the circuit.

"We have shown our apparatus attached to the bow of a vessel," said Professor Parker, "but it is obvious that it can be applied to any other part as well, and thus provide a certain means of defense. As a means of offense the importance of the invention will be readily seen, and it will also be noticed that if several vessels equipped with the helioscope and mariscope were approaching abreast a mine field or fleet of submarines a very extensive field would be illuminated and placed under observation, so that the object of danger could easily be destroyed. Furthermore, it is apparent that where the objects of danger are readily located a surface vessel, because of its greater speed and mobility, can easily avoid such objects, even if it cannot destroy them."

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THE UNITED STATES ADVISORY BOARD AND ITS PERSONNEL.

(*Continued from page* 399.)

Society of America. He is also a member of other scientific societies, including the Aerodynamic Commission of the Aero Club of America. Besides his other numerous activities in the realm of flying machines and allied devices, he has investigated the determination of air pressure on arched surfaces, and is the inventor of a stepped aeroplane that is the lightest machine so far built, it is said.

From the realm of mining engineering the Naval Advisory Board has been happily favored with the selection of two eminent specialists nominated by the American Institute of Mining Engineers. These gentlemen are William Lawrence Saunders and Benjamin Bowditch Thayer, both of New York City. Mr. Saunders is a mining engineer of great prominence and was born in Columbus, Ga., in 1856. He graduated from the University of Pennsylvania and for some time was in charge of the hydrographic work of the National Storage Co. He is serving at this time as president of the Ingersoll-Sargeant Drill Co., the Imperial Tool Co., and the Ingersoll-Rand Co., and at one time he was editor of *The Compressed Air Magazine.* He is a specialist in the design of compressed air machinery and has invented many important devices in this field. Mr. Thayer was born in San Francisco and graduated from Harvard University. He is a well-known mining engineer and is president of the American Institute of Mining Engineers, and, industrially, he is president of the Anaconda Mining Co.

This brilliant staff of specialists includes two all-around men of science, as selected by the American Chemical Society, in the persons of Dr. Leo H. Baekeland, of Yonkers, N. Y., and Professor William R. Whitney, of Schenectady, N. Y. As a chemist of repute Dr. Baekeland is well known. He has also produced several important industrial productions based on chemical affinity. He was born at Ghent, Belgium, in 1863 and graduated from the University of Ghent, where he served later as Assistant Professor and the Associate Professor of Chemistry. He also has been Professor of Chemistry in the higher Normal School at Bruges. He is also the inventor of the well-known Velox gaslight paper so widely used by amateur and professional photographers, and besides invented the famous Bakelite used very extensively for all kinds of electrical and other insulating requirements. Professor Whitney was born at Jamestown, N. Y., in 1868 and graduated from the Massachusetts Institute of Technology, where he served afterward as Instructor, Assistant Professor and finally as Professor of Chemistry. The greatest electric corporation in the world—the General Electric Co.—now counts him as one of its most valued men, and he is the director of the research laboratory of that immense industrial and scientific organization, which has solved more problems of an electrical and other nature than probably any other industrial concern of similar age.

From the field of electro-chemistry there has been contributed to the Board two able authorities: viz., Professor Joseph William Richards, of South Bethlehem, Pa., and Lawrence Addicks, of Chrome, N. J. Professor Richards is the instructor in metallurgy and mineralogy at Lehigh University. He was born at Oldbury, England, in 1864 and his early education was obtained in the public schools of Philadelphia. He was honored with degrees from Lehigh University and later spent considerable time in advanced study at Heidelberg, Germany. Mr. Addicks is considered an authority on the metallurgy of copper, and acts in the capacity of superintendent of the plant of the United States Metal Refining Co. at Chrome, N. J. He was born at Philadelphia in 1878 and graduated from the Massachusetts Institute of Technology with the degree of Bachelor of Science in mechanical and electrical engineering. He has held important positions as consulting engineer

and is very well known in his chosen line of work as a man of great ability and resource.

HOW THE "WIRELESS WIZ" CELEBRATED XMAS.

(*Continued from page 397.*)

run out again should the current be fed to the third rail of the side-track. The track switch is pulled into the straightaway by operating the switch 10. The express train will then continue to run around and may be reversed and backed into its station, 'B.' The freight train can be backed off the siding by closing the switch 3, and by means of the current reverser, X^2, can be made to go around the track. It is understood that by properly manipulating these switches and working the rheostat R that some quite effective situations may be created.

"An electric whistle was mounted in one of the stations, and this was operated by a push button before the train was started.

"The electro-magnetic stops are made as depicted in sketch C, and consist merely of a bent strip of brass or small wood box supporting an electro-magnet, to which is pivoted an arm, 1, which is raised into position by the electric current in the coil, to throw the current reverser on the train in the usual manner.

"The Christmas tree was supported from the ceiling by means of a turnbuckle, and on the bottom of the trunk were mounted two large wooden pulleys, as in this figure, D. A friction drive from the motor, M, and the pulley, G, gave sufficient reduction gearing, so that the tree would run very slowly. I had concealed about two dozen tiny lamps in the foliage of the trees, which were fed through a commutator (see D), arranged as detailed, to cause the lamps to flash; furthermore, some of the trimmings were coated with calcium sulphide, which glowed in the dark after the lights were shut off.

"The second pulley, H, by means of a belt-drove pulley, I, in the reverse direction to that of the tree. The shaft of this pulley was fastened to the drum in the lighthouse, on which was mounted colored sheets of celluloid. The body of the lighthouse was made of stiff cardboard, and in the top was mounted a high candlepower tungsten lamp. The wires from this lamp and the revolving cylinder were arranged as in sketch E. The rocks scattered around the scene consisted of 'willemite' that glowed under the effects of the ultraviolet light. This light was generated by means of an arc lamp (made as in Fig. F) and hung behind the rear screen, which had a half-moon shaped hole cut in it and cheesecloth pasted over it. The sea was made of thin, blue cloth on which was laid strips of cotton batting. A rotating fan underneath the platform caused upheavals of the cloth, and the cotton rolling back and forth gave the effect of rollers breaking on the rocks. The scenery was made from ordinary sheets, and the mountains, etc., marked in with charcoal."

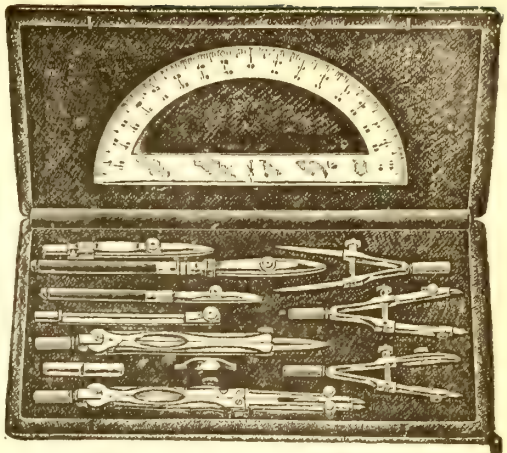
"I suppose you used the old scheme of the microphone to open the doors," I broke in.

"Yes," he replied, "the same old thing, except that the relay, after once closing, kept the contacts closed and supplied current to the motor until the door was fully opened, when the circuit was broken by means of two springs; here's the hook-up. I'll mark it Fig. G."

"Well, I'll never forget that scene," I remarked as I was leaving.

"Yes, and I'll never forget the job I'll have in cleaning up in time for the New Year's party," grunted the "Wiz."

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WIRELESS TOP FOR AN AUTOMOBILE.

A report from Belgium tells of the most extraordinary use of an automobile top. It seems that a British patrol succeeded in capturing a German touring car in which two officers were seated. The motor had broken down, and the officers were made prisoners.

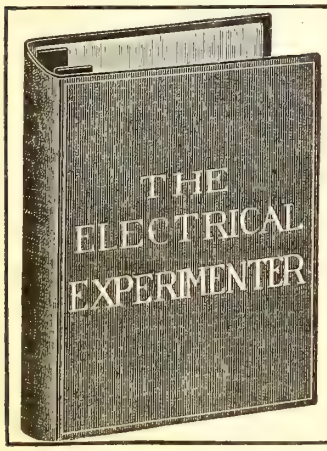
In glancing over the car one of the patrol noticed a wire connection to the metallic "skeleton" of the raised top. Following the wire, he pulled from under the seat a telephone receiver, and holding it to his ear was dumfounded when he could plainly hear a message coming from nowhere in particular.

The top skeleton formed the receiving wires of a wireless station, and the message came from the nearest headquarters of the army corps to which the officers belonged.

The companies constructing the new steel barges that will ply the Mississippi River use electricity to insure absolute safety from fire for their cotton and other inflammable cargoes. Electric energy is now used to operate the motor-driven cranes for loading and discharging cargoes and for cooking and heating in the officers' and crews' cabins.

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On your absolute guarantee that your 20 Lesson Wireless Course is just as described by you, you may send me same *FREE*. You are to send me this Course at once, all charges paid, and enter my name for a full year's subscription to the *Electrical Experimenter*, 12 numbers, for which I enclose *$1.00, the price of the Electrical Experimenter alone.

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SEEING A BASEBALL GAME BY WIRE.

(*Continued from page* 400.)

produced that the spectator really thinks he is at the actual field. Every movement made at the regular ball ground is shown instantaneously at the miniature one here shown. This is accomplished by means of an operator situated on the field, who telegraphs each movement that occurs on the whole field; even if the players are practising or the mascot lifting the bat off the ground, etc. All this is carefully and exactly shown on the screen.

The entire scheme is based on the reversed motion picture theory; instead of the film moving from one reel to another in front of a light, the light moves behind a fixed transparent film. This film or transparent screen, to be more exact, is a solid mass of miniature baseball figures, anyone of which becomes animated with the switching on of an electric light in the rear. Each figure is carefully concealed in a light-tight box, and when a play is about to be enacted, the operator moves his light along a line of the figures, each becoming successively illuminated and instilled with life in due course.

The players run bases, sliding head or feet first, jump into the air for the ball and in exactly the same way as the player does in real life. Also, as the photograph shows, a miniature bleacher crowd is placed in front of the screen, and at either side of same are mounted complete score boards, which give the names of the players, their position on the team, the "runs," "hits" and "errors." "Outs," "balls" and "strikes" are duly recorded instantly by electric bulbs, placed alongside these terms, and which appear in the illustration.

This wondrful device is the outcome of three years of continuous labor and ingenuity on the part of George S. Coleman. Photograph by courtesy of I. Stein, of Life-Like Baseball Player Co.

WITH THE AD MAN.

The service as rendered by some magazines to their readers is something like "clam digging," which is "neither fishing nor farming," and always hard to define. The new service we are trying to give to readers of the *Electrical Experimenter* will not be an indefinite something, but always definite, and really valuable.

How many times have you wanted to make some particular article or piece of apparatus, and found when one-half completed you were unable to obtain some part or material which was absolutely essential? Most frequently, when that happened, you had to let matters rest, until by accident or by long search you located the manufacturer or dealer of the article you wanted.

With our wonderfully large research facilities we can almost always place you in immediate touch with the manufacturer or dealer of just the article you want.

This service will be free of charge to you, and we know you will appreciate it.

Address your letter to the Advertising Dept., and I will see that every endeavor is made to supply you with the information you desire. MILTON HYMES.

The Electrical Experimenter

MAR 14 1916



★ BALL LIGHTNING See page 468

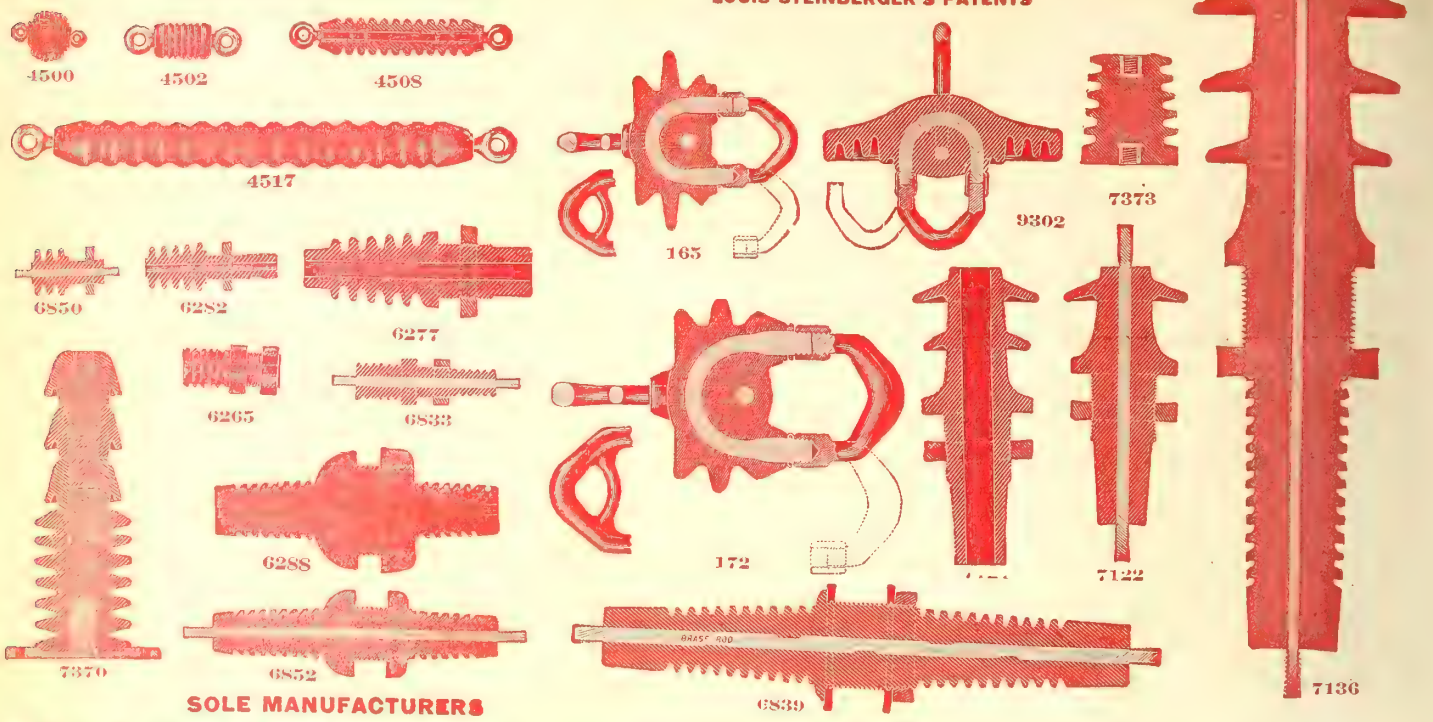
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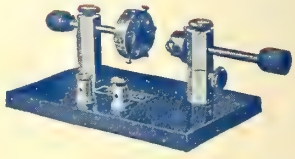
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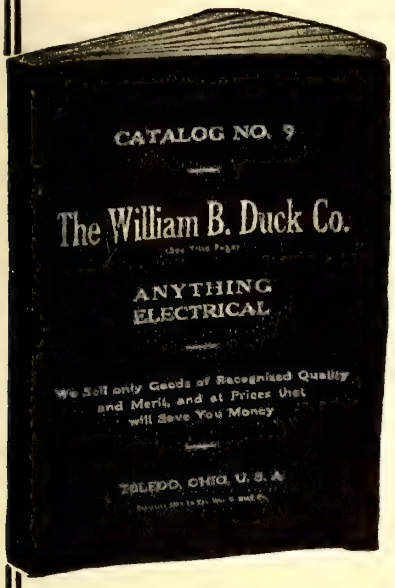
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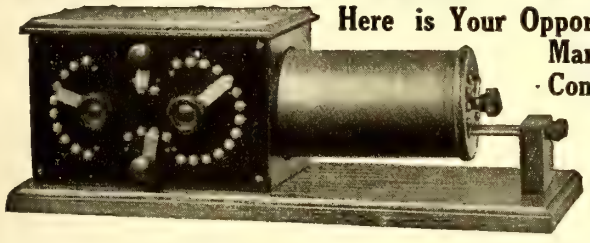
and substantial reductions on many popular wireless instruments and standard electrical supplies.

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Here is Your Opportunity to Secure the Best Navy Type Loose Coupler on the Market. Regular Price - - - - - - $15.00 $10.00
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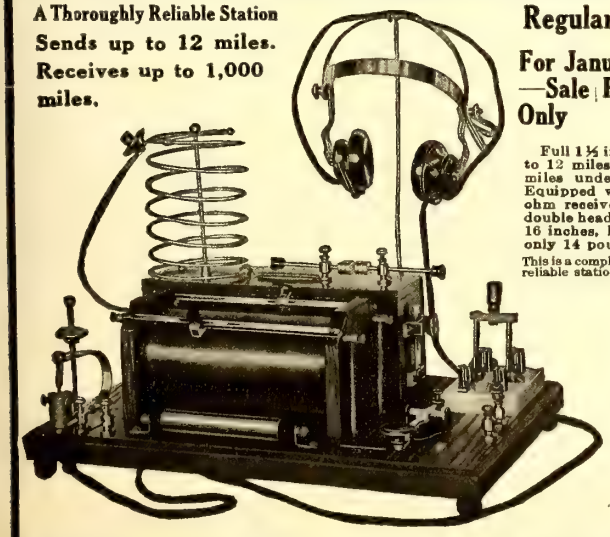
A brass lacquered 6,000 meter inductance tuner, perfect in every detail. Equipped with four point loading inductance which increases the wave length 4,000 meters over the average Navy Type Transformers. The primary winding has 24 taps—one switch controls the primary in groups of tens, the other controls one turn at a time—and is equipped with a dead end switch. Enclosed in a cabinet, the front of which is polished hard rubber. The secondary coil is wound with double silk covered wire and the inductance is varied by a ten point switch. With this coupler the very finest and most accurate tuning is easily and quickly secured. With a good sized aerial the reception of wave lengths up to 6,000 meters is possible.

All Finished Parts Ready For Assembling With Full Instructions, Special $6.50

Our No. 810 Complete Sending and Receiving Station

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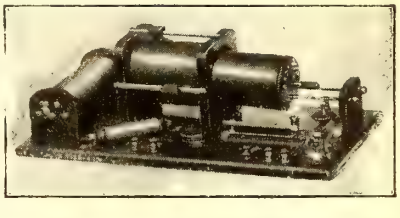


Full 1½ inch coil type. Sends up to 12 miles. Receives up to 1,000 miles under favorable conditions. Equipped with 2 double pole 1,000 ohm receivers, 6 feet silk cord and double headband. Size of base 12 x 16 inches, height 13 inches, weight only 14 pounds.

This is a completely equipped and thoroughly reliable station, mechanically and electrically perfect and ready for instant service. Nothing better in this class was ever constructed. The new improved tuning coil enables you to tune in or tune out any party you might desire, thus eliminating any interference. The set consists of a 1½ in. Spark Coil, 12 Flat Plate Condensers, our "Don't Jar Out" Detector, Buzzer and Switch to tell if your detector is working, Double Slide Silk Wire Wound Tuner for long wave station capacity, Fixed Condenser, Helix, Key, DPDT Switch and complete 2,000 Ohm Headset.

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OUR SPECIAL TIME SIGNAL RECEIVING OUTFIT
REGULAR PRICE $10.85—SALE PRICE **$8.10**



This is our new 1915 model made of the highest grade material obtainable. Double slide coupler for close tuning is wound with No. 24 green silk covered wire on the primary — the secondary with No. 28. There are 8 points to divide its capacity. A 3,000-metre loading coil placed between the coupler and the aerial by a switch that throws it in or out of the circuit enables you to receive amateurs with the coupler alone and long wave stations by the addition of the loading coil. One fixed condenser of proper capacity, improved universal detector, one buzzer test to test your mineral and potentiometer. This instrument is assembled on a highly finished oak base. All metal parts are heavy nickel-plated.

This station, with our Navy Type Loose Coupler, as illustrated above. **$15.00**

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FREE—Write our Query Department—write us and we will give you free technical advice on all wireless questions.
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Multi=Audi=Fone

The new wonder in the wireless world. It increases the Audibility 1,500 Times

Are you from MISSOURI? Then read these LETTERS

F. B. Chambers & Co., Wireless Engineers, 2046 Arch St., Philadelphia, Pa., write:

"On Tuesday evening we gave a demonstration of the Multi-Audi-Fone, to about 300 men; technical and experimenters.

"The hall in which the demonstration was held is about 75 x 150 feet and the signals from all stations—working at the time—could be heard all over the hall; and the louder ones could be heard in another room, back of the main hall. Even the Amateurs came in 'howling,' and the aerial used was only 3 wires and about 40 feet high.

"Everyone was more than surprised at the results, and believe us when we say—that it surely was some amplifying; *and there is nothing that can anywhere near touch the Multi-Audi-Fone.*"

Jeffries-Young Antenna Co., of Atlantic City, N. J., write:

"The Amplifier and Multum in Parvo Set received from you are giving wonderful results, and come up to the mark on every claim made. The Arlington Signals before audible with the Phones 12 inches away, can now be copied in nearly every room in our house, on St. Charles Place, where our winter station is located."

W. O. Horner, of Cleveland, Tennessee, says:

"I have been trying your Multi-Audi-Fone out as an Amplifier. . . . I was more than surprised at its sensitiveness. . . . It is certainly wonderful."

Again he writes: "Yours of the 28th at hand. I use a Triple Valve Station of highest class and thought I had the best on the market but when I hooked your Multi-Audi-Fone to the third Audion I was astonished at its Amplification.

"I laid your Phones on the table and walked 125 feet to the rear of my store and copied Arlington and Key West at 9:30 P. M. Many 600 Meter stations I also copied at this same distance. *I also hooked your Multi-Audi-Fone to a single Audion and signals were much louder than all three of my Amplifiers.*"

S. Kruse, of Halstead, Kansas, writes: **"Multum in Parvo is a wonder."**

M. B. Schwartz, of Brooklyn, N. Y., writes:

"With regard to results obtained on connecting the Multi-Audi-Fone in my Radio receiving set as an Amplifier, I am glad to say that I was astonished by the roaring and whistling of myriads of stations, near and far, many of which I never heard before; the small amateur stations coming in so loud that they were heard all over the room—it was like opening up a new region, fertile with activity and life, heretofore unknown. It may also probably be of interest to you to know that I heard the SS. Brazos every evening from the time she left San Juan, P. R., Oct. 20, until she reached New York, during the run she came in with remarkable audibility.

"The above is precisely what happened after including the Multi-Audi-Fone. Signals were heard all over the house for a distance of from 50 to 100 feet from Phones."

F. S. Hammond, of St. Marys, Pa., writes:

"With Amplifier, my Tuner Galena and small horn attached to one of your Phones, Arlington can exactly be read in any part of the room. Substituting Audion for Galena nearly doubles strength of signals, making them readable in hall downstairs."

Glenn Sabin & Co., Wireless Engineers, of Northampton, Mass., write:

"We have demonstrated your Multi-Audi-Fone to a number of experimenters and the results were surprisingly satisfactory.

"We have picked up stations with a single Multi-Audi-Fone, coupled to a single Audion, which we have been unable to get with a double Audion."

"*For getting Arlington time there is nothing that can touch it.*"

"On our aerial we can pick up fellows fifty and sixty miles away operating on half and three-quarter inch spark coils, which is excellent work to say the least and proves without a doubt that the Multi-Audi-Fone is an Amplifier that cannot be beaten."

WE GUARANTEE the Multi-Audi-Fone for THREE YEARS

With fair treatment it ought to last one hundred years

REMEMBER THESE FACTS

that the Multi-Audi-Fone works equally well with damped and undamped circuits and will work equally well with any Detector or Receiving Set, and that it will not cost you more for batteries than.....

TEN CENTS A MONTH

Our regular orders have already increased to such an extent that we are now compelled to withdraw our ten-day trial offer

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Why don't you buy yours now and GET THE PLEASURE OUT OF IT?

Multum in Parvo Receiver, including Crystaloi Detector and Buzzer.....$20.00
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THE CHRISTMAS PRESENT OF ALL CHRISTMAS PRESENTS, our complete Wireless Set.....$45.00 or $50.00

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The Electrical Experimenter

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Vol. III Whole No. 33 **CONTENTS FOR JANUARY, 1916** **No. 9**

FRONT COVER—"BALL LIGHTNING" ..... —
From a painting by Thomas N. Wrenn.
ELECTRICAL DEVICE DETECTS SUBMARINES 20 MILES AWAY 461
NEW INSTRUMENT ELIMINATES FOG PERIL 463
HIGH VOLTAGE SWITCH ARCS THAT RESEMBLE LIGHTNING 464
TAKING MOTION PICTURES WITH UNDER-SEA SEARCHLIGHT 466
SOME MODERN APPLICATIONS OF THE X-RAY 467
BALL LIGHTNING 468
MEASURING THE HEAT OF DISTANT STARS 470
NEW ARMY FIELD TELEPHONE AND BUZZER DEVELOPED BY U. S. SIGNAL CORPS 471
THE PONIATOWSKI RAY ..... By George Frederic Stratton. 472
BARON MUNCHHAUSEN'S NEW SCIENTIFIC ADVENTURES. By Hugo Gernsback. 474
HOW "WIRELESS WIZ" WELCOMED THE NEW YEAR ..... By Thomas W. Benson. 476
PERPETUAL MOTION, THE FOLLY OF THE AGES ..... By H. Winfield Secor, E.E. 478
THE TRANSMISSION OF PHOTOGRAPHS TELEGRAPHICALLY ..... By Samuel Cohen. 482
RADIO DEPARTMENT 485
WIRELESS ON THE FIRING LINE 485
REGENERATING AUDION CIRCUITS FOR WIRELESS RECEIVING ..... By F. J. Collins. 488
THE CONSTRUCTOR DEPARTMENT 492
HOW TO MAKE A SIMPLE STATIC MACHINE. By E. F. Hallock. 492
ELECTRICAL HELPS FOR AMATEUR PHOTOGRAPHERS .... By P. Mertz. 493
HOW-TO-MAKE-IT SECTION 496
WRINKLES, RECIPES AND FORMULAS. Edited by S. Gernsback. 499
WITH THE AMATEURS 500
LATEST PATENT DIGEST 502
PHONEY PATENT DEPARTMENT 503
QUESTION BOX 504
"PATENT ADVICE" ..... Edited by H. Gernsback. 513

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The Collapse of the Submarine War

IN our July issue we stated editorially: "In analyzing past and present means of warfare, we invariably find that it is possible to combat weapon by weapon." After a brief statement showing how at that time the submarine could not be combated with existing means, we continued: "Our imagination need not be stretched unduly to presume that electricity will, in the not too distant future, be employed to render the submarine harmless."

Within less than six months this prophecy has come true, as was to be expected. When Germany declared her historic submarine war against England in February, 1915, things looked indeed black for the British Admiralty as well as for British shippers. Germany, as usual, struck swiftly and with terrifying results. In February her submarines sank 8 vessels. In March, 32 vessels were sent to the bottom, while in April, 21 fell prey to this modern electric monster of the deep.

Thus, from February till August 30 altogether, 197 ships had been sunk at various points around the British Isles. Then suddenly, as if by magic, the sinking of ships by submarines stopped. Indeed, during the entire period from September 1, 1915, until December 1, 1915, only 33 ships had been sunk by German submarines. (The last figure also includes ships sunk by the Austrians in the Mediterranean, as well as small fishing craft.)

Although we know that a great many German submarines were sunk by England and France during the submarine war, it is certain that Germany has more undersea craft to-day than at the start, for submarines are relatively cheap, and can be built quickly if necessary. Nevertheless, as each week passes, fewer and fewer ships are reported sunk, and the day is not far off when German submarines will cease to exist altogether as far as England or France are concerned.

Once more science—and particularly electricity—has triumphed; a silent, but nevertheless a remarkable triumph of mind over matter. War is no longer man against man, brain against brain; it is machine against machine, science against science. England and France have a number of efficient schemes to-day with which they combat the submarine with electricity, either directly or indirectly, and although this particular branch of science is less than six months old, the results have been more than encouraging to these countries. One of the schemes in use, said to give entire satisfaction, is described in this issue of the *Electrical Experimenter*. Various other schemes using super-sensitive microphones under water have been reported from time to time, and we are informed that England has lately equipped all her war vessels with an electrical device which not only detects submarines, but their exact location as well. This device, so far, has been carefully kept secret, as is only natural.

Thus the battleship has come into its own again, instead of going to the scrap heap, as was feared in some quarters when the submarine war was at its height. The submarine, on the other hand, has been relegated to its former station, that of a defensive weapon, for which it is admirably suited, not for offensive purposes.

While Austria has been busy of late sinking a few ships in the Mediterranean, we can safely predict, that as soon as France and Italy have equipped their shores and their ships in the same manner as has been done in the Channel and in the North Sea, these submarines also will be reduced to impotence.

H. GERNSBACK.

THE ELECTRICAL EXPERIMENTER is published on the 15th of each month at 233 Fulton Street, New York. There are 12 numbers per year. The subscription price is $1.00 a year in U. S. and possessions. Canada and foreign countries, $1.50 a year. U. S. coin as well as U. S. stamps accepted (no foreign coins or stamps). Single copies, 10 cents each. A sample copy will be sent gratis on request. Checks and money orders should be drawn to order of THE EXPERIMENTER PUBLISHING CO., INC. If you change your address notify us promptly, in order that copies are not miscarried or lost. *A green wrapper indicates expiration.*

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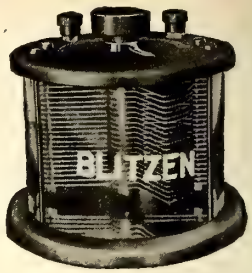


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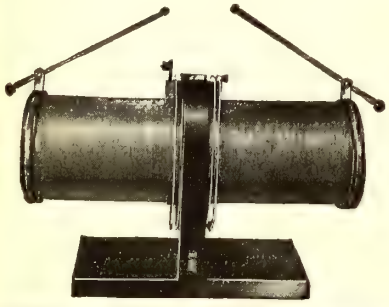
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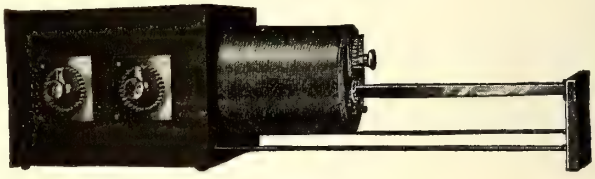
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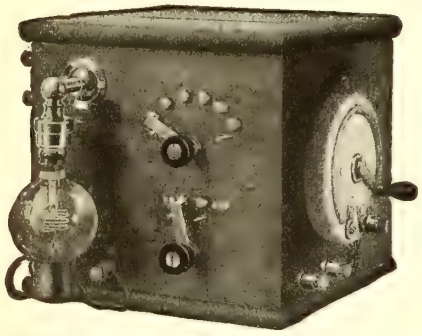
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THE ELECTRICAL EXPERIMENTER

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Vol. III. Whole No. 33 JANUARY, 1916 Number 9

Electrical Device Detects Submarines 20 Miles Away

THE long sought for solution of the submarine detection problem has apparently arrived in the form of a specially tuned microphonic device which is placed below the surface of the water along the coast line, and in the following paragraphs the general principles utilized in exactly detecting and locating the position of a submarine, when it is totally submerged, are explained.

The American electrical engineer, William Dubilier, recently returned from France, has developed this "submarine detector" to a high degree, and in his research work he had the co-operation of Prof. Tissot, the noted French scientist. A properly designed microphone or sound-operated instrument, which will translate sound energy into a corresponding electrical current, forms the nucleus of this remarkable invention which, it is said, has aided in doing away with a formidable number of German "U" boats around the French and English coasts. When sound waves impinge against the diaphragm of a microphone (which corresponds in general to that fitted on an ordinary telephone apparatus with which we are all familiar), it causes a variation of the inherent electrical resistance of this instrument, owing to the different pressures exerted against a number of small carbon balls, placed in a cup back of the diaphragm.

Contrary to the general opinion which might prevail in such a case, it is not the sound of the propellers or the engines of the submarine that are heard best, according to Mr. Dubilier, but the high humming note produced by the electrical motors utilized in propelling the submarine when submerged beneath the surface of the sea. Thus a most important point is gained, for if it were the former which emitted the sound waves used for the successful operation of this latest scientific device, the possibilities are that very little success would be attained, as the engines are not used except when cruising on the surface. It has been found that if the microphone is placed in a properly tuned resonance chamber, located about 20 feet below the surface of the water at the shore testing station, this particular humming note reverberated by the entire metallic shell of the submarine, can be selected and then intensified by means of suitable amplifiers, such as the well-known Audion type, developed by Dr. Lee de Forest.

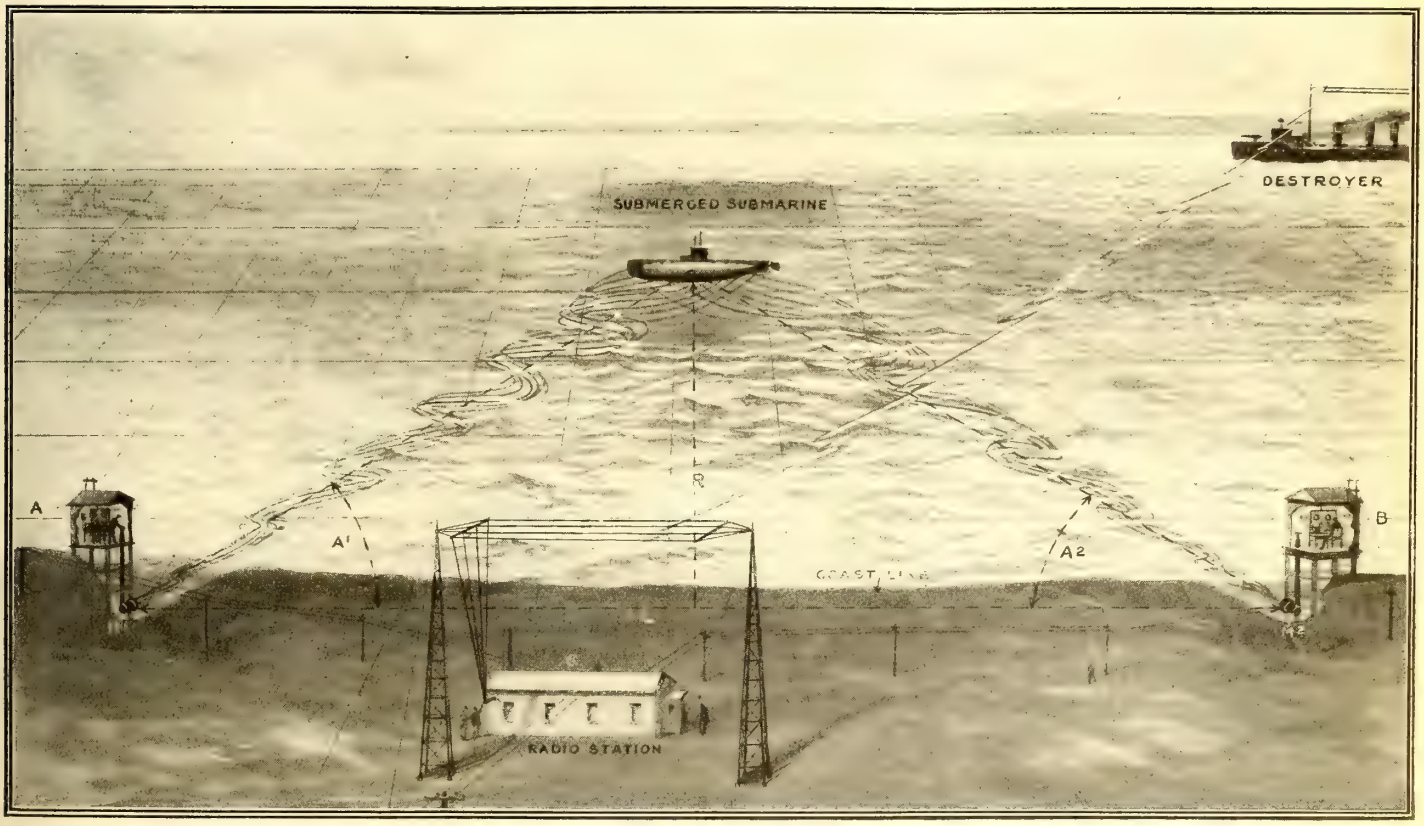


Fig. 1. Diagram Showing How Science Now Locates Submarines, Even When Submerged, by Means of Sensitive Electrical Ears That Pick Up the Peculiar Note They Emit.

This particular note, so effective in the successful operation of Mr. Dubilier's instrument, has been found to have a frequency period of about 750 cycles per second. The illustration herewith shows the inventor of this clever scheme for detecting submarines, holding one of the super-sensitive microphones, and, also Fig. 2, shows a detail photograph of the microphone proper. Several methods for filtering out the extraneous sound waves trans

mitted by passing steamers and the like were successively tried out, but the best method of all was ascertained to be the one embodying the use of resonance tubes, incorporated in the shell containing the submerged microphone. In this way it was found possible to closely tune the micro-



William Dubilier, the American Engineer, Has Perfected for the Allies a Successful Submarine Detector. He is Here Observed Holding the Super-Sensitive Microphone Used.

phone chamber, so that it would respond to the vibrations of the order above mentioned only, or to any desired harmonic of this frequency. These have proven very successful and are now being used by all submarine detecting stations located on the English and French coasts.

The resonance chamber, tunable to any desired musical note frequency, and in which the microphone proper is placed, is shown in Fig. 3. This consists of a stout outer steel chamber A, in front of which is placed a metal diaphragm B. Even at a very little submerged depth the water pressure against the diaphragm is severe indeed, and to counteract this, compressed air is fed into the chamber A, to offset this water pressure on the exterior casing. The diaphragm B is rigidly supported in the heavy outer chamber, which is pivotly mounted on the directing rod, as observed. There

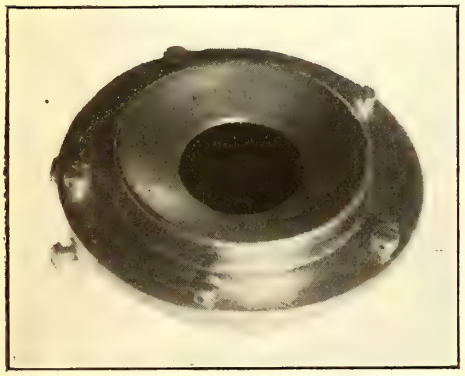


Fig. 2. Appearance of Sound Detecting Microphone Which, Submerged in the Waters Along the Shore, Indicates the Presence of Undersea Craft.

is carefully fastened to this a steel resonance tube, which consists of two distinct tubes, one sliding within the other so that it may be adjusted for any note desired. Both of these tubes have diaphragms in them, as perceived from the sketch, and in the same way as an organ pipe vibrates at different frequencies, depending upon its length; so this resonance tube vibrates to some particular note, depending upon how far apart the diaphragms in same are situated. Hence this remarkable device will not only respond to one particular note accurately, but it will, owing to the phenomenon of resonance, respond with maximum efficiency to that note, and in this way the microphone is affected in the most powerful manner possible for any given signal or sound wave. Flexible and heavily insulated wires lead up from the microphone to the operator in the detecting station, located on the ground above. In this station is located the Audion amplifier apparatus, as well as the telephonic and telegraphic instruments for communication with the wireless station and with the second detection station.

The large illustration, Fig. 1, here portrayed, gives a general layout of the scheme, as it is applied in practice. As observed, a submerged submarine is seen progressing from right to left across the view. Of course, if the submarine should stop its propellers and likewise its motors or engines, and submerge to the bed of the ocean, or bay, no sound would be heard. But, on the other hand, it could not very well start up the propellers and get away without being at once detected by the observers stationed at the various shore stations. The underlying principle governing the detection and accurate location of a submerged submarine is based on the same methods as used in modern long distance gun sighting. Let us assume two detecting stations at A and B, respectively, and at a certain known distance apart, as indicated by the line L. Also that these stations are telegraphically or telephonically in communication with a wireless station C, as well as with each other. Now when the operator located at station B rotates his submerged microphone by means of a suitable shaft and gear arrangement, etc., until the incoming submarine note is heard loudest (or, as a matter of fact, as soon as he hears the note at all), he immediately notifies the operator at station A of this fact. Operator A then endeavors to tune in the submarine's note to a maximum value, and when both A and B have their instruments so set that the note is heard at maximum strength, then the angles A_1 and A_2 are definitely known from the calibrated dials fitted to the microphone controlling shafts. It is now a simple matter to make the calculation (usually by means of a slide rule, specially constructed), to find the exact range or distance R, between the submarine and the base line L.

Also to facilitate matters in this respect, the water is definitely laid out in squares, as indicated by the lines in the drawing. These lines, of course, are only imaginary, but they are exactly plotted on the maps used by the military authorities in charge. All these squares are numbered and, therefore, it is an easy matter to give explicit directions through the wireless station C, to a waiting torpedo boat destroyer so that this terror of the submarines may proceed quickly to the exact square in which the submarine is to be found. The under-water craft may be moving into a second or third square from that first communicated to the commander of the torpedo boat destroyer, but that is a small matter and is checked up constantly by A and B and then transmitted to the commander through the wireless station; thus keeping him acquainted with the definite whereabouts of the under-sea boat every few minutes.

In most cases the submarine, after a short while, comes to the surface to make observations, as otherwise it is running blind so far as events above the surface of the water are concerned. In a remarkable number of instances this method has worked, it is said, with wonderful success, and as soon as the submarine came to the surface, it took but a few moments to either destroy or capture it by means of the destroyer, which was on the spot at the instant the submarine shoved its periscope above the surface of the sea.

So we see that while the submarine has been developed to a wonderful degree, in so far as range and other features are concerned, there has been devised by scientists a method to counteract their efficiency. In less time than it takes to tell, a torpedo boat destroyer may be despatched to the exact spot where the submarine is so peacefully pursuing its way and, as it supposes, unseen and unknown.

Or, again, it is possible to send an aeroplane to the scene, equipped with powerful explosive bombs. On the latest type of these aerial bombs, designed for the destruction of submarines when under water, there is provided fluted tails which cause them to go straight down into the water for a considerable distance without deviating from the point originally aimed at. The aeroplane has proven one of the best detectors of submarines when it happens to be known where the submarine is located. Although not generally known, it has been definitely proven that the observer in the aeroplane flying at a considerable distance above the water, and regardless

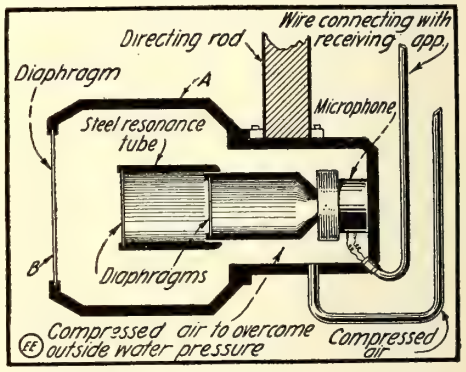


Fig. 3. Details of Specially Contrived "Resonance Tubes" and Microphone Arranged in Stout Water-proof Shell.

of the wave formation on the surface, can detect accurately the presence of a submarine even though submerged 75 to 100 feet below the surface.

It may be said in conclusion that these marvelous submarine detectors have not proven satisfactory for use on ship-board, but this point will probably be overcome in the near future. This is accounted for by the noise and severe vibration encountered on the vessel itself on which such apparatus has been installed. However, it has proven a Godsend to those responsible for the protection of the water adjacent to the English and French coasts, and it is hoped that the United States Government will not be dilatory in recognizing the merits of this most ingenious device which has been the goal of many hard-working engineers and scientists in the United States and abroad for a number of years.

Wellesley College girls will eat electrically prepared food in their new central dormitory. The new wing is equipped with a special three-oven 12-foot range and a bake oven with a capacity of 90 one-pound loaves. The equipment will serve 250 students and help.

New Instrument Eliminates Fog Peril

NAVIGATORS before long may find fog robbed of its terrors through a device invented by Dr. A. G. Webster, of Clark University, Worcester, Mass., for showing the direction of signals, which he demonstrated recently at the final autumn session of the National Academy of Sciences held in the American Museum of Natural History at New York. The apparatus, which he calls a "phonometer," translates the intensity of sound into terms of light or intensified sound, as by ringing a bell, so that, as the inventor expressed it, the deaf may see and the blind may hear it.

Impressed with the loss of the steamship "Empress of Ireland" in 1914, he went to Father Point, on the St. Lawrence, where the vessel was sunk in collision and 1,200 perished, and there made the experiments on which his invention is based.

In a thick fog, when two vessels are approaching each other, it is often impossible for the captains to tell within 45 degrees the direction of the sounds from horns. In the St. Lawrence disaster the masters of both vessels should have stopped, in his opinion, in view of the uncertainty of determining the direction of signals in fog.

First Professor Webster showed a resonator or "phone" which took up the vibrations of a tuning fork and emitted a sound of standard pitch. This instrument took the place of a regular fog signal. The receiving instrument, or phonometer, looked like a small round box on a tripod, and from each end of the box projected a conical horn resembling a megaphone. The small ends of the horns were turned toward each other.



Remarkable Scientific Visual Fog Signal Receiver Devised by Dr. A. G. Webster, of Clark University. Insert Cut at Left Shows Details of Receiver Mechanism.

The device is placed so that the horns are at right angles with the course of the vessel on which it is installed, as seen in our illustration. The vibration caused by the signal is concentrated by the horns and communicated to a metal diaphragm, which is held in place by small steel wires. The pulsation goes to a tiny electric light, and the effect upon it is registered by the reflections of a mirror on a scale which can be read through a glass attached to the instrument (see detail insert cut). The scale shows the intensity of the sound as the image of the light widens or contracts. The horns swing easily upon a pivot (readily controlled from the ship's bridge by an electric controller as depicted, hooked up with a small electric motor geared to the rotatable horn chamber mounted on the mast). When they have been so adjusted by the operator that they show the greatest intensity, the tube of the instrument is pointing in the direction from which the signal is being sounded.

With the phonometer, although it is not absolutely accurate in its present stage, Dr. Webster declares that the direction can be determined within a very few degrees. Experts who witnessed the demonstration said that if the device could show within five to 10 degrees it would be of incalculable value.

The inventor himself saw a practical objection to the device in that to have it of universal use the navigation laws would have to be changed so as to prescribe that all fog horns and sirens be of the same pitch. As at present the actual variation of horns is within an octave or an octave and a half, he does not regard this objection as insuperable. He thinks that the Government of the United States would be well within its rights in standardizing fog horns. It would be too much to expect the masters of vessels to tune up their phonometers to correspond with the timbre of every new siren. In connection with wireless messages, it is believed that the phonometer would be of value, for ships approaching each other could communicate details about the fog horns employed as a further guide.

Dr. A. A. Michelson, of the University of Chicago, said: "I cannot withhold my admiration. This paper marks a most notable advance in the effort to solve a problem of the greatest interest. It seems to me that Dr. Webster has brought to a brilliantly successful conclusion this important research."

It seems that an important function of this phonometer would be in discovering and locating the whereabouts of icebergs. This could be accomplished by sending out a siren note so that it would be reflected, in the form of an echo, from the iceberg. By measuring the reflection angle at two different points, say at either end of the ship, it would be possible to quickly calculate the distance at which the iceberg was situated. This follows the same practise used in getting the range for big guns.

DRIVES AIRSHIP BY WIRELESS.

The invention of a German engineer, Herr Bohle, which he demonstrates nightly in a large vaudeville house of Berlin, is attracting considerable attention. The invention consists of an airship in miniature (about 3 meters long and 1½ meters in diameter), which the inventor drives by means of wireless electric currents from a battery stationed afar. No personnel is required to drive this airship, which executes every maneuver the inventor desires. Even explosives can be dropped from this airship on high at the will of its master at his station below, it is claimed.

Expert engineers declare that the great question is whether this airship can be constructed on a larger scale and managed from a greater distance. If so, another upheaval in military warfare may be expected.

ELECTRIC COMPASSES ON AMERICAN BATTLESHIPS.

Motor-driven gyroscopic compasses have now been installed on 20 United States battleships, one armored cruiser and 15 submarines. Master compasses in duplicate are soon to be placed on all battleships of the Delaware and later classes. The Bureau of Navigation maintains with the Atlantic fleet two chief gunners who have been specially trained as gyro-compass experts, and it is the duty of these men to inspect and adjust the compasses and to give instructions in their use. Special attention is also given to the instruction of officers and men in the care and use of the compasses, the ship's crews who have to do with these compasses being sent to the New York Navy Yard or the works of the manufacturer for 30 days' instruction.

High Voltage Switch Arcs That Resemble Lightning

THE spectacular set of photographs on the opposite page are not those of lightning discharges, although they very much resemble them indeed. They happen to be the arcs occasioned when opening high tension transmission lines with air-break switches.

These photographs were taken during night tests made on the efficiency of air-break switches for high tension transmission lines at the Virginian Power Co.'s generating plant at Gainesville, Ga. Oscillograph records were also made to show the fluctuation of the currents on the lines due to the heavy arcs formed when these swtiches were suddenly opened. The tests covered the performance with lines carrying actual energy loads of considerable amperage and, also, with simply a charging current load, which latter reached a value of 22 amperes on the average, with a leading power factor.

Referring now to the illustrations here shown of the arcs created when opening some of these air-break switches, the upper left view shows the spectacular effect due to breaking a line of 50,000 volts potential and 18 amperes of current. Note the wavy formation of the flaming arc produced. It is certain death to be within sparking distance of such a discharge. It lasts usually only a fraction of a minute, or until it has opened the circuit.

The top central photo shows the appearance of the arc when the switch is opened on a 114,000 volt, 27.5 ampere line. Particular attention is called to this excellent picture with respect to the ladder seen in same, and some idea as to the size of the discharge or flame may be thus obtained. This particular flame discharge was over 20 feet high! The ladder is a regular standard size one. The arcs blew downward, then between the phases, with loud reports and also overlapped the overhanging leads. Considerable heat usually accompanies these arcs in air.

The illustration in the upper right corner portrays the arc effect taking place when a 64,000-volt line, carrying 18 amperes, is suddenly disrupted with an air-break switch. Here the arcs were almost perfectly straight between the switch blade and horn, and measured about six feet long. Note the beautiful curved shape of the arcs. The horn wires of the air-break switches are clearly observed.

The lower left view is that of the arc occurring when opening a 111,000-volt line carrying 26.8 amperes. Here the arcs measured about 12 feet long and they tended to hold to the lower part of the blade, breaking before rising along the horns. A particularly fierce and hot arc formed here, and attention is called to the wavy ribbon-like effect developed at the upper end of the flames.

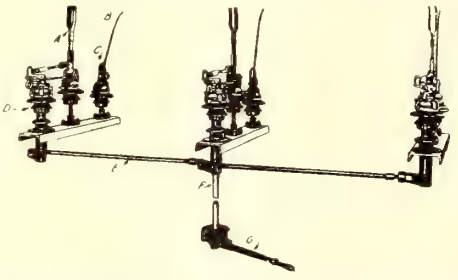
The lower central illustration is that of the air-break switch arc on a 76,000-volt, 21-ampere transmission line. A slight wind was blowing at the time this switch was opened and tended to blow the arcs sidewise. The arcs proper measured about eight feet long, but finally broke all right in a short time. The discharges are more concentrated, apparently, but evinced the same persistency in hanging on as those previously cited.

The final photo, shown in the lower right corner of the group, depicts the performance of one of these switches on a 118,000-volt line with a 21-ampere load. The arcs in this case were very long, but rapidly rose up the diverging horns, and thus got out of the way of the framework and finally broke all right. Note the great spread of the arc flame at the extreme right of this view. The diverging horns of these air-break switches are supposed to cause the arcs to rise quickly and thus lengthen out and become broken finally, but in some instances this action does not take place as per schedule, giving rise to some of the spectacular arcs here portrayed.

These tests were conducted for the purpose of determining the effect on the transmission lines of breaking the circuit with air-break switches, as compared with oil switches, and for the purpose of determining the arcing characteristics of the three different type switches tested.

None of the switches were sufficiently spaced, and the tests proved the minimum distance between phases recommended for 44,000 volts should be at least seven feet. As constructed for these tests one switch was spaced six feet between phases and the others only four feet.

It was found that extremely high winds of about 50 miles per hour velocity greatly aided in breaking the arcs formed by light loads, as the arcs were blown from the diverging horns before the switches were even wide open; but under heavier loads, with the spacing of phases used in these tests, the high winds would blow the arcs across the phases and trip the circuit breakers at the power house before the arcs



Type of Three-Phase Air-Break Switch Employed in Opening High Tension Power Lines. The Insulated Handle G and Shaft F, Swing the Crossbar E. This Turns the Insulated Spindles D, Linked Up to the Switch Blade A. The Jaw of the Switch Appears at C; While B Is the Horn Arc Arrester. Three Switches Are Thus Controlled by the Handle G.

would let loose from the horns or blades. The conclusion was also reached that it was much more difficult to break simply a charging current load than a true energy load of the same K.V.A. value. (One K.V.A. equals 1,000 watts at 100 per cent. power factor.)

The testing engineers stated as their opinion that the proper design of an air-break switch involved a mechanical movement in opening the switch that would aid the arcs in rising up the horns. The theory that the heat of the arc alone will carry it up the horns is doubtless well founded, but this force is only great enough to accomplish this result in a perfectly still atmosphere. With the slightest wind blowing, the arcs are blown sidewise and the tendency of the arc to rise more or less counteracted by this horizontal wind pressure. If, however, the mechanical movement is such as to draw the arcs up the horns, the tendency to rise is increased, and it is much easier then to break the arc. The arc appears to be a sort of uncontrollable featherlike medium, and but a slight wind will blow it eight or ten feet horizontally.

These tests were made in all kinds of weather, such as snow, rain and clear weather.

The chief difficulty experienced in the use of air-break switches is the large amount of space necessary for their construction, and it is plainly apparent that the spacing used by manufacturers of to-day is not sufficient, it seems. In some cases the arcs are blown downward, and this means that the switches must be well insulated from the steelwork supporting them for a distance sufficient to keep the arcs from thus grounding the lines.

These wonderful photographs were obtained through the courtesy of Charles O. Lenz, chief engineer for the Virginian Power Co. and the Georgia Railway & Power Co.

"EDISON DAY" AT 'FRISCO EXPOSITION.

On October 21 the whole country celebrated "Edison Day," commemorating that eventful day just 36 years ago when the first Edison electric incandescent lamp was perfected.

At the Panama-Pacific Exposition in San Francisco, where Mr. and Mrs. Edison were guests, a telephone connection was made between Mr. Edison's home, at West Orange, N. J., and the fair grounds. While the inventor, aided by a special sound amplifier, listened in San Francisco, a long message from Miller Reese Hutchinson, superintendent of the Edison Works, was transmitted by Mr. Edison's own phonograph.

The message congratulated Mr. Edison on the 36th anniversary of his invention of the incandescent light, and told him that several hundred of his friends had gathered in his home to do him honor.

Mr. Edison's reply was received by his latest invention, the "telescribe," and later every one in the room received a cylinder on which the words of the inventor had been transcribed automatically.

Many people of prominence journeyed to Edison's home and found the streets about it lighted by 5,000 candle-power lights, while immense searchlights played on it from the roof of the laboratory.

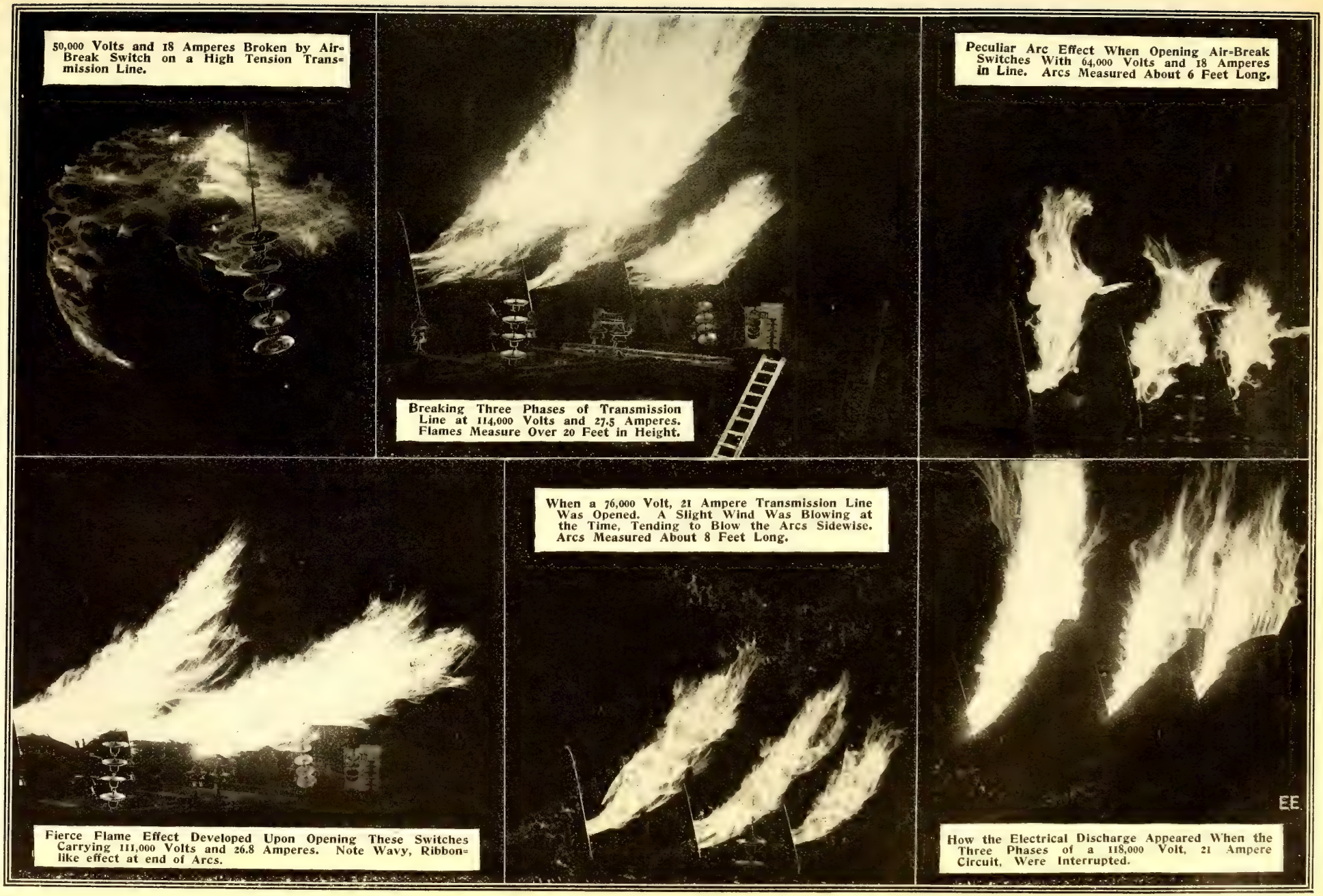
The trans-continental wire worked perfectly, and the voices of all those who spoke were heard distinctly. Mr. Edison's voice preserved all its characteristics in the transmission over 3,400 miles, and those who knew him instantly recognized the speaker. Mr. Edison, in turn, assured those in his laboratory that he heard perfectly. He then said:

"It may seem strange to those who know of my work on the telephone carbon transmitter that this is the first time I have ever carried on a conversation over the telephone. Trying to talk 3,400 miles on my first attempt at a telephone conversation seems to be a pretty big undertaking, but the engineers of the Bell System have made it easier to talk 3,400 miles than it used to be to talk 34 miles. In my research work I have spent a great many years listening to the phonograph, but it gives me a singular sensation to sit here in California and hear the new diamond disc phonograph over the telephone all the way from Orange, N. J. I heard the record of Hutch's talk very plainly. I should now like to hear a musical record.

"That's fine," he said, after a record had been played. He was asked to play the record back from San Francisco and a machine at that end was started and the West Orange audience heard the music.

John J. Carty, chief engineer of the American Telephone and Telegraph Co., who was "listening in" at Chicago, said:

"This wonderful transmission of sound will become historic because of the conveyance of a perfect recreation of music and voice to the ear of the world's most illustrious inventor by his own invention."



50,000 Volts and 18 Amperes Broken by Air-Break Switch on a High Tension Transmission Line.

Breaking Three Phases of Transmission Line at 114,000 Volts and 27.5 Amperes. Flames Measure Over 20 Feet in Height.

Peculiar Arc Effect When Opening Air-Break Switches With 64,000 Volts and 18 Amperes in Line. Arcs Measured About 6 Feet Long.

Fierce Flame Effect Developed Upon Opening These Switches Carrying 111,000 Volts and 26.8 Amperes. Note Wavy, Ribbon-like effect at end of Arcs.

When a 76,000 Volt, 21 Ampere Transmission Line Was Opened. A Slight Wind Was Blowing at the Time, Tending to Blow the Arcs Sidewise. Arcs Measured About 8 Feet Long.

How the Electrical Discharge Appeared When the Three Phases of a 118,000 Volt, 21 Ampere Circuit, Were Interrupted.

SPECTACULAR ELECTRICAL DISPLAYS OCCURRING WHEN HIGH TENSION AIR-BREAK SWITCHES ON TRANSMISSION LINES ARE OPENED

Taking Moving Pictures with Under-Sea Searchlight

Some time ago there was developed a special submerging bell made of heavy steel and of sufficient size to accommodate a powerful searchlight, together with a motion picture camera and also the operator for same, so that moving pictures of the beds of rivers, coral formations, wrecks, etc., might be taken. Instead of going to such expense and trouble, there is suggested and illustrated herewith a much simpler method which would seem just as effective.



Proposed Scheme for Taking Submarine Motion Pictures by Means of Powerful Electric Searchlight Worked in Conjunction with the Camera From Above the Water's Surface.

In this arrangement there is provided a set of four steel cables properly rigged up with winding drums, etc., on a float or raft, as perceived, and at the end of these cables is secured a motion picture camera, electrically controlled by means of insulated wires leading down one of the cables and secured thereto. In the top of the camera is mounted a powerful electric lamp with lens, etc. The operator on the surface is enabled to view the wreck or other submarine scene through a periscopic tube, more properly known as a "mariscope." The sighting tube may be turned in any direction and, of course, the camera may be raised and lowered to any depth or height in the water desired.

The cables, as will be evident, are wound up over the drums on the float or raft, and to enable this function to be performed properly the mariscope or sighting tube is made in the same fashion as a telescope, i. e., of gradually decreasing sizes of tubes sliding one within the other. A substantial watertight camera and high candlepower lamp are necessary for this purpose; the machine could be constructed of steel and provided with a properly fitted door for permitting a new film to be readily inserted and the old film removed when the device is above water. A storage battery or dynamo on the float will supply current for the lamp, and camera, and pictures can be taken in this way either in the daytime or at night. Undoubtedly many wonderful and valuable pictures could be taken in this way which would not only be instructive for use in theaters, schools, etc., but also vitally important to lecturers on certain subjects and for the benefit of salvage and wrecking companies which have to deal with submerged boat wrecks and the like.

TRAFFIC COP AN ELECTRIC SIGNALMAN.

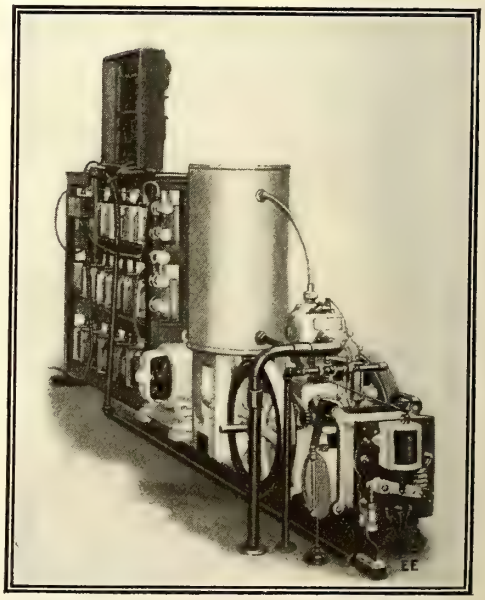
The traffic policeman in Cleveland has been turned into a "signal officer." The green and red lights adopted on railroads have been installed on all Cleveland's main street corners. Electric lights facing oncoming vehicles and hid from view in the opposite direction are located on the right hand side of each street. The red light denotes "Stop," the green light "Proceed." To clear the crossing in case of fire the officer simply throws on an emergency switch, which sounds an alarm bell and turns on red lights.

AN AUTOMATIC ELECTRIC LIGHTING PLANT.

The problem of electric lighting as regards ease and convenience has been satisfactorily solved in cases where central station service is available, as all that is required is the turning on of a switch. In country houses and private installations of a similar description, however, unexpected difficulties have been encountered, such as the requirement of frequent attention and the employment of some technical man in order to look after the apparatus.

It is, therefore, interesting to note the arrangement of a recently devised automatic lighting generator set which works at all times whenever its services are required. This plant is shown in the accompanying illustration and is the product of an enterprising electrical concern of New York. No attendant is required to start and stop the plant, but it is sometimes necessary to fill the tank with water and to clean and oil the engine, which does not require much technical knowledge. To start the plant it is only necessary to switch on three or four storage batteries, which supply the power; these are shown on the extreme left. As soon as an additional lamp is turned on more current is consumed and a relay is actuated which connects the dynamo to the batteries, which then acts as a motor. This in turn drives the engine until the proper normal speed of same is attained, and at the same time electrically firing a gasoline charge in the engine, which causes it to run and thereby drives the dynamo. As soon as the dynamo begins to generate, a relay is thrown automatically, connecting the lights to the dynamo mains; also, the storage batteries are then being charged. The most interesting point about the engine is that it will run faster when additional lights are put in circuit. This is accomplished by means of an automatic control operating the gas valve, and which is actuated by the current that is supplied to the line.

This is another advance in the realm of the isolated electric plant, and one which undoubtedly will be advantageous to those who lack central station electric service, as in the Middle West and suburban sections all over the country.



Remarkable Electric Lighting Plant That is Entirely Automatic in its Action. Turning on a Single Lamp Starts the Engine and Dynamo, Charging the Storage Battery, etc. It Stops Itself as Soon as All the Lamps Are Extinguished.

NOVEL ELECTRIC CLOCK INDICATES TIME DIRECTLY.

By Felix J. Koch.

"I set my clocks by Edward's watch," the young housewife remarks proudly, as you marvel that every clock in Newly-Wed's home strikes the hour in unison with all others; and this with the time absolutely correct.

"Edward, you know, sets his watch each evening by the big clock at Fifth and Vine streets," and as does "Edward," so does everyone else in Cincinnati; for, in addition to achieving renown for being the most complicated and largest electric clock in the American mid-west, this clock is known to be absolutely correct.

In fact, already, this clock, mounted on the corner of a leading department store in the Queen City, has become a feature of the place.

In addition to being operated by electricity, the correct time comes to the clock from the Western Union people every second. Some notion of the complexity of the arrangement for keeping it exact is to be gained by the statement that in putting it up the services of five men were required for some ten days, and that not less than five miles of wire is used between clock and store. Innumerable lamps are required to give the proper arrangement for displaying the changing time by night, when the clock is, of course, at its best; and with these the connections must be exactly right. To that end, again, the electricians state, there are 800 connections in all. If one of these goes wrong, they are all wrong.

While in course of construction the big clock was tested every two hours, now it is looked over four times a day. In fact, five men were put in charge to test and connect.

And yet, wonderful as it may appear, these experts are on hand, as precaution alone, since *de facto* the great clock now runs itself and does not need this checking up.



Day and Night Views of Unique Electric Clock That Indicates Time Directly in Hours and Minutes, as Observed.

What is more, a clock of this sort will last well-nigh forever. With a dial of 12 inches diameter, the clock itself measures 18 by 36. With sign and other ornaments besides, then, it measures 12 by 15 feet.

Naturally, to the expert, the big clock presents the solution of many problems indeed; but the public finds greatest interest here in watching the momentary changing of the sign when it states:

"The Correct Time Is,"

and then gives this, in hours and minutes, as the illustration shows.

Some Modern Applications of the X-Ray

In order that this country may preserve its strict neutrality, and fearing that the Germans or their sympathizers may place bombs or infernal machines, or copper (which is contraband), in bales of cotton, such bales are daily inspected, the operator's body is exposed to the rays, and to protect him from their injurious effects a lead screen is placed in front of the examiner, as our photograph illustrates.

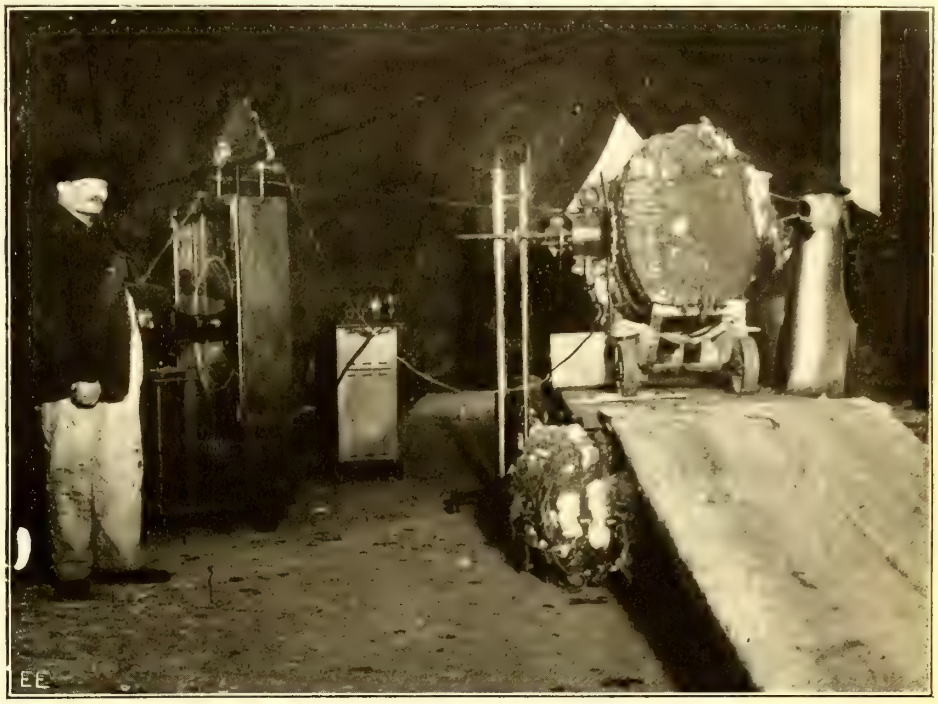


Photo Copyright by Underwood & Underwood.

Powerful X-Ray Machine Used by United States Government to Detect Bombs, etc., Hidden in Cotton Bales Before Shipment.

our Government has taken advantage of the X-rays.

The photograph herewith shown depicts a bale of cotton being examined by a powerful X-ray tube for any concealed contraband. The high-voltage direct-current machine is seen at the left; this is one similar to that described in the April, 1915, issue of this journal. The current is transmitted to the tube on the right by two flexible copper conductors. The tube is supported by means of an adjustable stand, as perceived. Due to the continuous use of the machine, as thousands of such bales are daily inspected, the operator's body is exposed to the rays, and to protect him from their injurious effects a lead screen is placed in front of the examiner, as our photograph illustrates. Note the operator viewing the bale through a phosphorescent or platinum-barium-cyanide screen.

Another application of the X-ray is in detecting marked impurities in coal. This was suggested by S. Cohen, who explained that as carbon is very transparent to the Roentgen rays, while silica is opaque to them, the silicate which is the most common impurity in coal and which forms a slag when coal is burned, can be seen like a skeleton when the shadow of the coal is projected upon an X-ray fluorescent screen.

Another possible use of the X-ray is in testing precious stones such as diamonds. A real diamond is practically transparent to the ray, giving almost no shadow on the screen, while imitation diamonds are opaque to them.

AMATEUR GETS SPECIAL RADIO LICENSE.

The wireless station of John J. Grossman, 181 Hudson street, Tiffin, O. (formerly 8TI), has been recently converted into a special station by Radio Inspector J. F. Dillon (new call 8ZT). This station will be engaged in flood service and newspaper work. He will be glad to hear from anyone wishing assistance in relay work. Working hours, 7 p. m. to 10.30 p. m. Address all communications to above.

THE WASTE IN WOMAN POWER.

No one cares to think of the work that women do in terms of horsepower, least of all the women themselves, but a moment's study of these figures is startling in its revelation.

There are now 15,000 six-pound electric laundry irons in use in a large Eastern city. Few women and no men realize what this means in actual labor saving. Where one electric flatiron is now used the housewife formerly required at least three six-pound "sad" irons, and while one was in use two had to stand on the stove to heat. Fifteen thousand electric irons have therefore replaced 45,000 "sad" irons. At six pounds apiece, this means 270,000 pounds, or 135 tons.

Now, the constant use of this enormous amount of old irons meant a tremendous outlay of energy or exertion of strength that was required every ironing day, equivilent to 2,400 horsepower, and this was simply termed "woman's work!" It should be termed the waste of woman power!

Ball Lightning

BALL lightning, the subject here under discussion, is one of the three principal and distinguishing forms of this marvelous electrical disturbance taking place in nature, and which in its commoner forms all of us have undoubtedly witnessed at some time or other. These three principal forms of lightning, as this electrical phenomenon is called, comprise ball lightning, as just mentioned; streak or chain lightning,



Ball Lightning or "Fire-Ball" as it Appeared in France Some Years Ago. It is Supposed to Be a Gaseous Sphere Carrying an Electric Charge, and Is Liable to Explode if Impeded in Its Travels.

as manifested by powerful discharges taking place near-by, and the third form covers what is commonly termed sheet lightning. This latter is sometimes of an indistinct character, and may not be very noticeable, and this is often caused by lightning actually taking place at a considerable distance from the observer, which reflects from the clouds or firmament. This also includes the form of branched or forked lightning bordering on the kind just mentioned, or combined with it.

Most of us know how to protect ourselves from this pyrotechnical display occurring in nature, and one of the best ways is to recline in a hammock suspended in the center of a room with respect to the four walls, floor and ceiling, the hammock being hung preferably on silk ropes. It should not be placed under a chandelier. Care should be exercised in keeping away from open windows, doors, chimneys, fireplaces and stoves, or, in fact, any metallic or conductive body which might tend to gather a charge or act as a highly conductive path for a lightning discharge which might strike the building. It is a pretty thoroughly accepted axiom to-day that if a building is properly protected with well-grounded lightning rods that they will cause any lightning discharges to proceed harmlessly to earth without any spectacular effect, such as noise or auroral display. It is best during such electric storms to keep the doors and windows closed, as a draft of air often causes a lightning discharge to enter through such openings. Soot-covered chimney flues are another attraction for lightning discharges.

Ball lightning is one of those freakish things which one seldom sees, yet one that does really take place, as many witnesses of such displays are willing to swear to, including a number of irreproachable scientific writers, such as Camille Flammarion. In case ball lightning enters a room it is best to get on a chair or some other article, so that the fire ball may not roll along the floor and burn the person. If the door is left open, the fire ball will most likely proceed on its way. Should one be standing on the floor near the door, it is possible that the ball might explode between the legs and cause fatal injury, as has occurred in a number of cases. Hence the precaution of standing on a chair.

Ball lightning, or the thunderbolt, as it was called by the Greeks, is a gaseous sphere without an envelope. It contains energy which is afterward released with explosive violence.

(1) It is a luminous ball which often occurs after an intense flash of lightning.

(2) As it falls it moves slowly and horizontally some feet above the earth.

(3) At sea it is most frequent.

(4) The mass of a thunderbolt is denser than air. In an air current of ether, or in the neighborhood of electricity, it explodes, and the explosive wave travels outward, followed by a strong smell of ozone. Then the ball is nothing but atmospheric gases, because:

Ozone is denser than air, and is produced under electric stress.

Ball lightning travels horizontally to the negatively charged earth. That it is repelled proves that ozone also is negatively charged. The energy liberated causes a transition of ozone to oxygen, and thus explains the explosion, as it is well known that oxygen supports combustion.

The illustration herewith presented shows a ball of lightning entering a stall in France. It rolled for a few seconds and finally moved toward the chimney, where it exploded with great violence.

Not long ago Count G. Hamilton made a record of a similar freak of electricity. He was sitting at dinner in a house on Lake Wener in Sweden when, just after a vivid flash of lightning, a brilliant white ball appeared, and, after hanging poised over the table for a few seconds, exploded with a loud crash. Fortunately it did no harm to anyone, although it was quite close to several people.

The most amazing effect of lightning was witnessed several years ago in a French field. During a thunderstorm several peasants took shelter near a tree, and a few minutes later a globe of lightning drifted toward them, like a soap bubble of blue fire. It surrounded them, injuring them to the extent of burning their hair and clothes, after which it exploded.

We hardly dare to experiment with lightning in any form as found in Nature. Several investigators have been killed outright by ball or other lightning discharges. Notable in this direction is the case of Dr. Richmann, who lost his life through such research work indiscreetly conducted. He had arranged an insulated iron rod from the roof of his house to his laboratory. This served to conduct the atmospheric electricity to him, and he made a practise of carefully measuring its intensity every day. However, on the day of August 6, 1753, in the middle of a terrific electric storm and while he kept at a safe distance from the metallic rod, awaiting time to measure the spark length, his assistant suddenly entered the laboratory, causing Dr. Richmann to momentarily approach the rod. A brilliant globe of blue fire leaped from the rod and struck him on the head, stretching him out on the floor, stone dead. Our front cover illustrates this sad occurrence vividly. This, to be sure, was hardly an encouraging start to the study of physics and science.

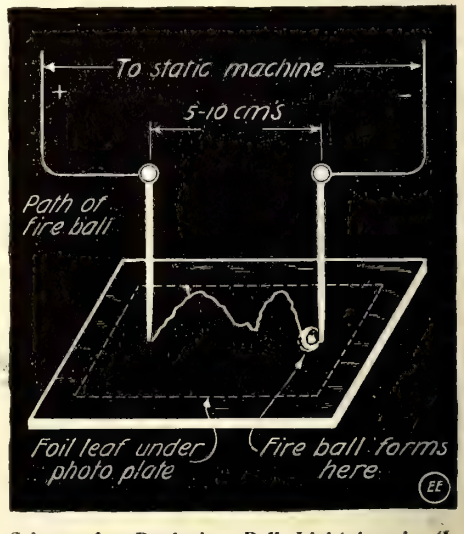
Camille Flammarion, the famous French scientist, cites several very interesting cases of "ball lightning" discharges. One of these occurred on August 24, 1895. During a violent wind and rainstorm several people saw descending to the ground a whitish-colored globe of about 1½ inches diameter. Upon touching the ground it split into two smaller globules which rose at once to the height of the chimneys on the houses close by and disappeared.

One leaped down a chimney, crossed a room in which were a man and a child without harming them. It then proceeded through the floor, perforating a brick with a clean round hole about an inch in diameter. Under this room was a sheepfold. The shepherd's son, seated at the doorway, suddenly perceived a brilliant light shining over the flock of sheep, while the lambs were jumping about in fright. When he approached them he was startled to find that five sheep had been killed. They bore no trace of burning, or of any wound whatever, but about their lips appeared a sort of slightly pinkish foam.

In the adjoining house the second fireball had also gone down a chimney and had exploded in the kitchen, causing great damage.

A peculiar freakish effect often noticed and recorded in numerous instances is where ball lightning has appeared suddenly, passed through and around a number of people in a crowd, etc., and then as suddenly disappeared without doing any harm whatsoever.

In July, 1744, a German peasant woman was busily occupied in the kitchen superintending the family meal, so history relates. Instantly, after a terrible clap of thunder, she saw a fireball about three inches in diameter come down the chimney, pass between her feet without harming her and



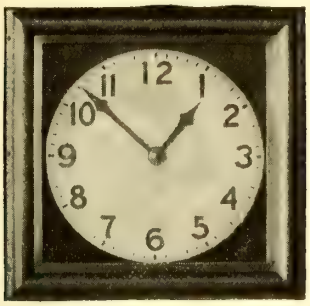
Scheme for Producing Ball Lightning in the Laboratory with Static Machine, Photograph Plate and Two Needles.

continue on its course nonchalantly without burning or even upsetting the spinning-wheel and other objects on the floor.

Terribly frightened, the woman tried to escape—she threw herself toward the door and opened it, when the fireball proceeded to follow her, playing about her feet, and passing into the next room, which opened out of doors, crossed it, and went on out

AN ILLUMINATED CLOCK FACE.

A certain kind of sign recently placed on the market consists of a heavy sheet of plate glass in which the design is deeply sand-blasted. The source of illumination is entirely hidden, and the light is reflected up



Electrically Illuminated Clock Dial in Which the Light Is Reflected Edgewise Through the Glass.

or down, edgeways, through the glass, thus giving a very pleasing and mysterious effect. The same plan has been followed in the design of the clock face shown in the accompanying illustration. The clock can be made to conform to any architectural design and may be provided with or without background. The frame for the clock may be either square, hexagonal or octagonal, employing four lamps, six lamps and eight tubular "linolite" lamps, respectively. The figures seem to stand out in space, giving an extremely novel and pleasing effect.

COLLEGE MEN TALK TO 'FRISCO.

A telephonic conversation between members of the faculty, alumni and student body of Stevens Institute of Technology, Hoboken, and President Alexander Humphreys and members of the alumni was held recently over the new line between New York and San Francisco. Dr. Humphreys was attending the organization meeting of the Stevens Club in San Francisco.

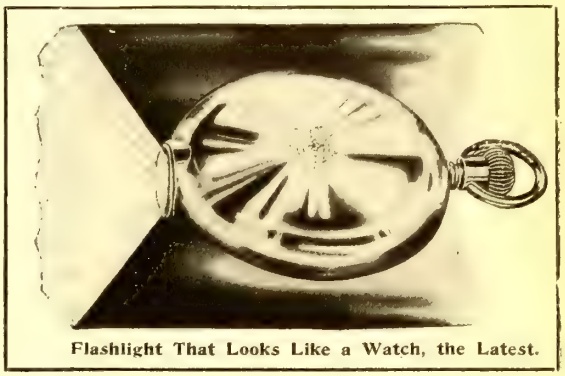
Twenty alumni of the institute formed the club, among them Dr. John C. Carty, chief engineer of the American Telephone & Telegraph Co., an honorary alumnus.

The exchange of greetings between the 'Frisco and New York parties began at 9 p. m. and lasted an hour. The telephone connection for the 3,000-mile talk was made in two minutes. At the conclusion of the conversation those in San Francisco held a banquet.

Those in the New York party included Prof. Albert F. Ganz, Prof. Adam Riesenberger, Prof. Charles F. Kroeh, all members of Stevens faculty; Newcomb Carlton, president of the Western Union Telegraph Co.; John Lieb, vice-president of the New York Edison Co.; Dr. David Jacobus, President Warner, of the Stevens Class, and Secretary Dunn, of the Students' Council. They gathered in the directors' room of the American Telephone & Telegraph Co., at 15 Dey street, New York.

FLASHLIGHT THAT LOOKS LIKE A WATCH.

The latest thing in electrical flashlights of the pocket type is that shown in the illustration and which corresponds exactly in size and appearance with an ordinary watch. The lamp is lighted by pressing on the stem and the specially designed battery is easily replaced by opening one side of the watchcase. This flashlight gives a strong beam of light and is probably one of the neatest designs of its kind brought out in a long time. It will appeal particularly to those wearing a double or breast



Flashlight That Looks Like a Watch, the Latest.

watch chain. This particular flashlight is known as the "Watchlite"; it is fitted with a tungsten lamp of the proper candlepower to be used in conjunction with the battery supplied with the device.

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into the yard. The fireball darted about the yard, entered a barn by an open door, climbed the wall opposite and, reaching the edge of the roof, it burst with such a terrific noise that the peasant woman fainted. The barn at once took fire and burned to the ground.

Another peculiar instance took place in 1903, while M. Lawrence Rotch (director of the observatory at Blue Hill, U. S. A.) was sojourning in Paris, France. It had for its locale the famous Eiffel Tower, rising majestically 1,000 feet above the earth in graceful outlines. Looking in the direction of this lofty steel structure during a heavy electric storm he saw the summit struck by white lightning coming from the zenith. Simultaneously he saw a fireball, less dazzling than the lightning, slowly descend from the summit to the second platform. It appeared to be about one yard in diameter and consumed less than two seconds to cover a distance of about 100 yards. Then it suddenly disappeared in a mysterious manner. The next day Mr. Rotch ascertained, on visiting the tower, that it had actually been struck by lightning *twice* on the previous day. It is to be noted that the ball did not follow the conductor; but, after all, the whole metallic tower structure certainly is in itself the most powerful lightning conductor imaginable. The enormous mass of steel rising skyward would undoubtedly neutralize in such a case the attraction of the thin metallic lightning rods, effectual for the protection of ordinary buildings, but apparently incapable of competing under such conditions with the attractive force of this gigantic metallic mass.

A thunderstorm burst over Mortrée (Orme), in France, on April 24, 1887, where the lightning played havoc in general. It literally chopped up the telegraph wire on the route to Argentan for a distance of 150 yards. The sections of the wire were so blackened that they could well have come from a forge; some of the longer ones were bent and their sections welded together. The lightning in one case entered a stable door in the form of an iridescent fireball. It approached a person who was preparing to milk a cow, and shortly afterward passed between the legs of the animal and disappeared without causing the least damage at all. The terrified cow raised itself on its hind legs, bellowing frantically, and its master, nearly frightened out of his life, ran away to a more secure place of refuge.

However, the apparently inexplicable phenomenon accompanying this unwelcome pyrotechnical display of Dame Nature was that occurring at the critical moment when the lightning crossed the stable, at which instant a considerable quantity of incandescent stones fell before a neighboring house. Some of them were the size of walnuts; they were, furthermore, not of a very thick material, had a grayish-white color, and could be easily broken by the fingers, when they gave forth the characteristic odor of sulphur. The smaller spheres exactly resembled coke. These facts just mentioned were set down at the time by the Minister of Post and Telegraphs.

It is possible to produce artificial fireballs or ball lightning, as it is more generally called, in the experimental laboratory. A suggestion to this end is given herewith, this idea being due to M. Stéphane Leduc, the noted French scientist. His experiment makes possible the production of a slowly moving globular spark not easily obtainable in any other way, in so far as we know.

To produce this imitation ball lightning it is necessary to employ two very fine highly polished metallic points, each of which is in connection with the positive and negative poles, respectively, of a static machine of small or medium size. These two metallic points must rest perpendicularly, as our illustration indicates, on the sensitive face of a gelatine bromide of silver photographic plate, which is placed on a metallic leaf, such as tinfoil. The two metal points are spaced about five to ten centimeters apart. When the static machine is operated an effluvium is produced around the positive point, while at the negative point there is formed a luminous fireball or globule.

Now, when this globule has reached a sufficient size, it will be seen to detach itself from the metallic point, which then ceases to be luminous, and the globule will begin to move forward slowly over the surface of the plate, taking various curved paths and eventually it will set off in a direction toward the positive metal point. When it reaches this electrode the effluvium is extinguished and all luminous phenomena ceases. Further, the static machine acts as if its two poles were short-circuited, or, in other words, united by a conductor.

The velocity acquired by the luminous globule as it travels is quite slight, it taking from one to four minutes for it to traverse a path of six centimeters in some cases, and before reaching the positive electrode the globe bursts into two or more luminous balls which individually continue their journey to the positive electrode. On developing the photographic plate (which, of course, should be placed under a ruby light while the foregoing experiment is conducted) there will be found a trace on it of the exact route followed by the spark globule—the point of explosion, the routes resulting from the division, and the effluvium around the positive electrode point. Also, if one should stop the experiment before the globule's arrival at the positive electrode, the photograph will only give the route to that point. The fireball takes for its course the conductor, which apparently short-circuits the static machine. If sulphur or some other powder is thrown on the photographic plate while the experiment is being conducted, and also while the ball is moving, its path will be marked by a line of aigrettes, looking very much like a luminous rosary.

[*The Editors shall be glad to hear from any of our readers who have made experiments in this direction. Photographs are particularly welcome.*—Ed.]

A submarine without electricity is as helpless as a baby. The electric current makes it easy of control by one man. It cooks, heats, ventilates, besides propelling this marvel of boats, when submerged.

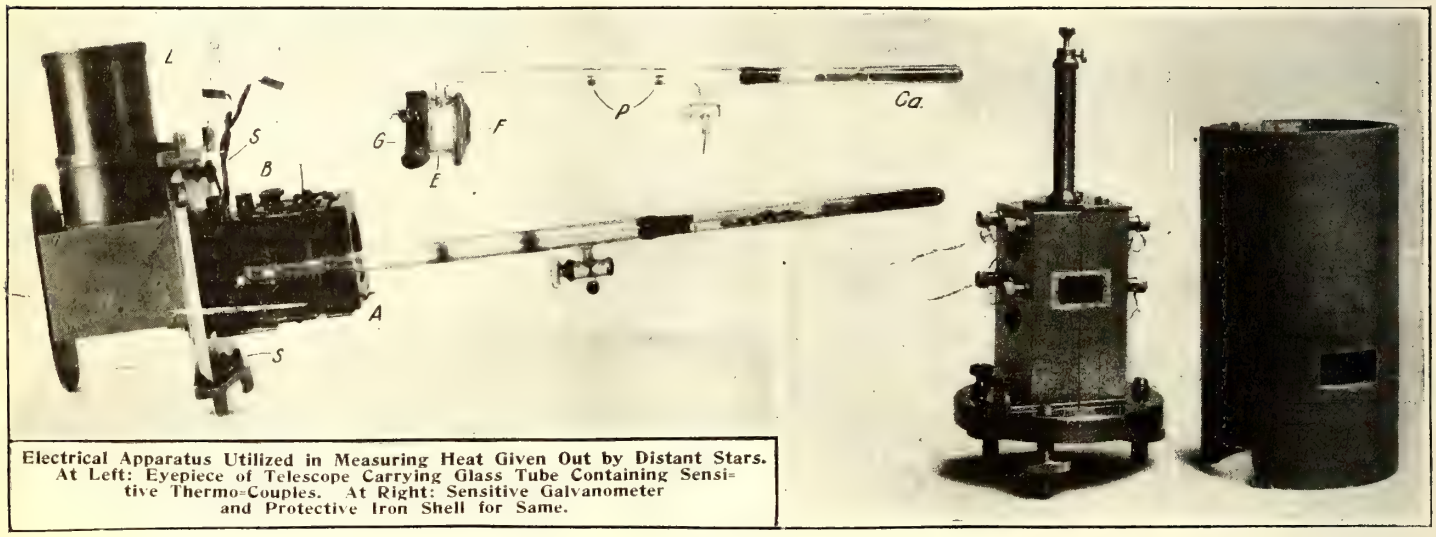
Measuring the Heat of Distant Stars

TO most people it will probably seem a waste of time and a useless expense to undertake scientifically the measurement of the heat from distant stars. Undoubtedly the popular question in such a direction would be—of what earthly use such a scientific test could be? But we should at least listen to the logic and scientific deductions of Dr. W. W. Coblentz, of the United States Bureau of Standards, who says that the measurement of the total radiation from stars may possibly be of use to us in answering the question as to whether or not light is absorbed in traversing interstellar space. Many other highly interesting scientific aspects of this problem are involved, and we give herewith a brief discourse on the electrical apparatus used in this most remarkable test. It is extremely interesting to note the fact that the heat measurement of the radiations from "Polaris" (the Pole Star), made in August, 1914, are ether vibrations *which were sent out by that interstellar body 47 years ago.* More remarkable still is the fact that similar radiations from the "Orion" group of stars started upon their long journey through space 160 *years ago!* When one considers these facts, the distances involved are so inconceivable that one naturally wonders how it can be possible that there is not sufficient "cosmic dust" in interstellar space to scatter, and thus diminish, the visible radiations to a greater extent than the invisible adiations; and yet the spectrographic evidence seems to be against this sought-for absorption of light in space. Another question awaiting solution is whether there is a "dispersion" of light in space, i. e., whether there is a retardation of, say, the violet rays as compared with the infra-red rays, so that the infra-red rays get here quicker than do the violet rays. This scientific problem may be determined or solved by measuring the radiation from an eclipsing variable star. If there is retardation of some of the rays, then the maximum and minimum of light emission should be different for different parts of the spectrum.

This and many other vitally interesting scientific conundrums await further investigation and solution.

The measurement of star heat had been attempted a number of years previous to the research work conducted by Dr. Coblentz at the famous Lick Observatory on Mount Hamilton, Cal., in the summer of 1914. In 1895 and 1896 Minchin conducted such tests, using a 2-foot reflector. He utilized the well-known selenium cell, which changes its electrical resistance in accordance with the amount of light thrown on same. It was found, however, that this method was not satisfactory to any extent, owing to the peculiar properties of selenium, which is highly selective, for one thing, in response to the different wave lengths; thus it is impossible for comparison with the present data obtained of the radiations from the different stars. This cell, however, is of practical value in measuring the maximum and minimum light emission from a variable star which does not change in color. It was used for this purpose by Stebbins in 1910 in conjunction with a 12-inch reflector.

Taking up the work of Dr. Coblentz, the photograph herewith shows the apparatus he used and which was placed on the powerful telescope at the Lick Observatory. Extremely sensitive and specially made thermocouples were used in this test, and the heat (light beams) of the distant star was projected through the telescope onto the thermocouple junctions; this created an electrical current which was registered on a sensitive reflecting galvanometer. The galvanometer was shielded by a heavy iron shell, which is also seen in the illustration, so as to be free from any external electric or electro-magnetic influences caused by the various moving parts on the telescope as it followed the star across the zenith.



Electrical Apparatus Utilized in Measuring Heat Given Out by Distant Stars. At Left: Eyepiece of Telescope Carrying Glass Tube Containing Sensitive Thermo-Couples. At Right: Sensitive Galvanometer and Protective Iron Shell for Same.

Referring to the thermocouples, these were composed of platinum and silver or bismuth and silver, in different cases, and encased in a glass chamber E; the projecting glass tube P was fitted with two electrical terminals employed for testing the evacuation value from time to time. In the front of the glass chamber E was placed a fluorite window F, through which the stellar rays were admitted, and which in turn fell upon the thermocouple, in this way producing a minute current, previously referred to. The star image and the receivers of the thermocouple were viewed from the side of the large telescope by means of a right-angle prism and lens which were mounted close to the glass window. The attachment L, containing the reflecting prism and the lens, is shown in the illustration herewith. The glass vessel containing the thermocouples is placed in a metal chamber B, attachable to the permanent equipment L by means of two thumb screws S S. In this way the radiometric attachment could be quickly detached and the regular photographic plate holder substituted, etc. The box B could also be rotated about the optic axis of the telescope. An absorption cell of water 1 cm. in thickness was placed in a hinged metal box observed at A. The resistance of the thin platinum wire used in making the thermocouple was very high, or about 2 to 3 ohms per millimeter. Only about 1.5 mm. of platinum wire was required. This wire was attached to a piece of silver wire 0.0165 mm. in diameter, which in turn was attached to the heavy lead wires. A globule of tin was attached to the platinum and pressed flat to form the receiver.

With this outfit as used by Dr. Coblentz it is possible to measure the heat radiations from stars down to the 6.7 magnitude. With this highly sensitive instrument stars were measured which were only 1/400 to 1/500 as brilliant as those formerly measured, or, in other words, the sensitivity was 400 to 500 times as great as previously attained. A very remarkable test of the sensitivity of the thermocouple radiometric outfit was made in connection with a sperm candle. It is asserted that the outfit was sufficiently sensitive to register the heat given out by a sperm candle when placed at a distance of 53 *miles from the thermocouple,* using a 3-foot reflecting telescope to pick up and intensify the rays given out by the candle at this distance.

A rough estimate of the total amount of heat received from the stars is of interest in this connection as compared with the heat received from the Sun, the latter being of the order of 1.9 gram calories per square centimeter per minute. From tests made on the star "Polaris" it was found that it would require the *total radiations* from that star to fall upon 1 square centimeter for 1,000,000 years in order to raise the temperature of 1 gram of water 1 degree Centigrade. In marked contrast with this figure is the comparison with the radiation from the Sun; in this case the heat falling upon the earth's surface in one minute is sufficient to raise the temperature of 1 gram of water 1 degree Centigrade. Recapitulating, it may be also stated that the radiations from all the stars which at any moment can fall upon 1 square centimeter of the earth's surface is so minute that it would have to be conserved and absorbed continuously for a period of 100 to 200 years in order to raise the temperature of 1 gram of water 1 degree Centigrade. Hence the incoming stellar radiations can contribute to the retarding of the cooling of the earth but little.

(*Continued on page* 522.)

ELECTRICITY RESTORES LIFE IN MOVIE PLAY.

In one of the latest spectacular motion picture productions, known as "Lola" and produced by the World Film Corporation, electricity plays a prominent part, as the photograph here shown portrays. A large static machine may be seen in the background of the picture. This particular photograph was produced by superimposing two other distinct pictures, hence it is really a triplicate print.

The original film production gives a very spectacular and weird effect indeed. The doctor is endeavoring to bring back to life the heroine, known as "Lola" (played by Clara Kimball Young), by passing electric charges into the body through two large-size Geissler tubes held in the hands, as may be observed in the picture. Electricity has made possible some of the very best film plays of a scientific nature, as notably exemplified in the famous "Exploits of Elaine" series, produced by the Pathé Co.

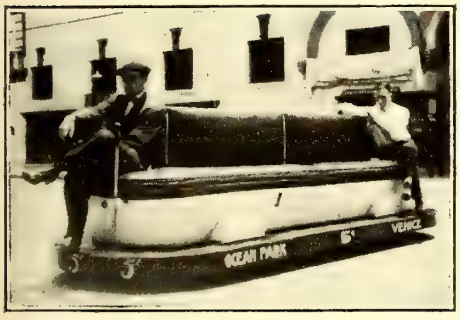


How Electricity Restores Life in Spectacular Film Play, "Lola."

THE ELECTRIC ROLLING CHAIR IS HERE.

The electric rolling chair is here, and by the way it is being patronized one would conclude that it is here to stay. Probably all of the beach resorts of the country of any importance have had rolling chairs of the man-power kind for years, but, so far as known, this is the first instance in which electricity has been brought into play in connection with this feature.

This new kind of "jitney bus," which has just made its appearance in Venice, Cal., is operated between that city and Ocean Park, a mile distant. Between these points a wide cement walk runs along the ocean front, providing an ocean view for the occupants of the car all the way.



Venice, Cal., Boasts an Electric Rolling Chair. It Holds 18 Passengers and the Fare Is a "Jitney."

This car is about 12 feet in length and has a capacity of 18 passengers in addition to the driver. It is operated by a single employe, the practise being to stop the car midway between the two cities and collect the fares. It is impelled by a motor of two-horse capacity and is capable of maintaining a speed ranging from four to 10 miles an hour. The current for the motor is obtained from storage batteries placed under the seat. As may be seen, a "jitney" is charged per ride between these cities.—*Photo by Albert Marple.*

ATLANTIC AND PACIFIC DINERS LINKED BY WIRE.

Communication by telephone between New York and San Francisco was held, without a break, for an hour recently, when members of the Rotary Club, who dined at the Hotel McAlpin, New York, talked with their friends who were holding a dinner on the 'Frisco Exposition grounds. The long talk was arranged by the New York Telephone Co., and several of the officials were present, including Belvidere Brooks, the general manager, who had a seat at the speakers' table.

The voices in San Francisco were heard distinctly, and members of the club in New York recognized their friends.

There were 450 at the dinner at the McAlpin, and everybody heard the conversations, as individual telephones had been connected with the tables. They heard also opera selections played in San Francisco on a phonograph. H. E. McClusky, a member of the Metropolitan Opera Co., who was at the McAlpin dinner, then sang for the benefit of the members of the San Francisco club. There was no doubt that they heard each word distinctly, for the applause was tremendous.

NEW ARMY FIELD TELEPHONE AND BUZZER DEVELOPED BY THE U. S. SIGNAL CORPS.

For military signaling requirements a most important device is the buzzer telegraph and telephone apparatus used by the Signal Corps Division of the Army. Uncle Sam's boys have lately developed a new instrument along this line which is shown in the illustrations herewith. It is known as the camp telephone, and the auxiliary apparatus which goes with the set is termed a service buzzer. The principal duty of the buzzer, which is specially constructed for the work, is to produce high-pitched telegraphic signals which may be carried over several miles of ordinary conductor. Besides such a signal can be heard, even when the line is broken in one or more places, as has been frequently found in tests made with this apparatus, or also when the line becomes short-circuited for some reason.

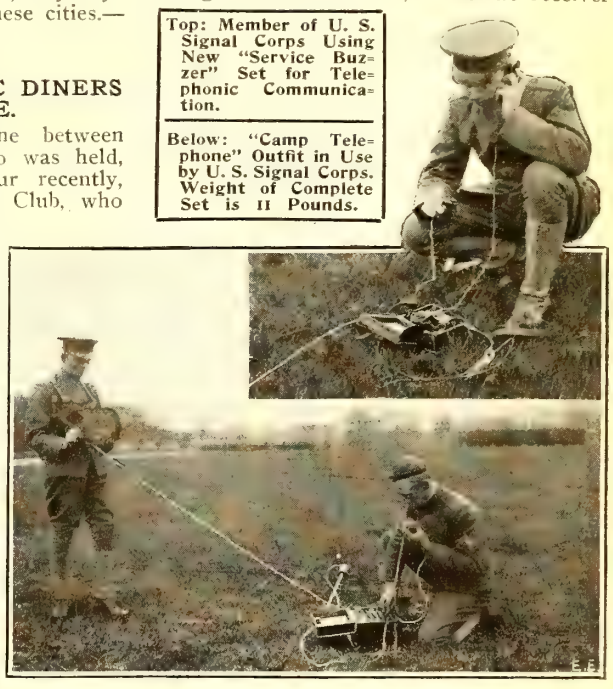
The camp telephone set is being distributed to the troops of the regular army at this time and supersedes the old field telephone outfit of the portable type. It may be used in any location and works remarkably well, indeed. The complete apparatus is enclosed in a rugged and serviceable folding case, weighing approximately 11 pounds. The instrument is of the local battery type and a small two-cell dry battery, such as those used in tubular flashlamps, supplies the current for the talking circuit.

The buzzer telegraph instrument may be utilized as a telephone set when necessary, but if the line should become severed, or if for any other reason, it may then be employed to transmit regular telegraph signals either by Morse or Continental code.

In the large illustration a member of the United States Signal Corps is shown using the camp telephone set, while one of the men holds the reel of flexible conductor used in running the line between two stations. The smaller picture shows the new service buzzer utilized for telephonic communication; the microphone of the set being held in the hand, while the receiver is pressed to the ear of the operator, as in using the regular telephone.

Top: Member of U. S. Signal Corps Using New "Service Buzzer" Set for Telephonic Communication.

Below: "Camp Telephone" Outfit in Use by U. S. Signal Corps. Weight of Complete Set is 11 Pounds.



The housewife walks a mile in an ordinary day's ironing—buy her an electric iron and curtail this unnecessary labor.

The Poniatowski Ray

By George Frederic Stratton

BY the San Elota water-hole on the parched Apirachie Desert the small party of United States troopers were camped, the coatless—some shirtless—men sprawling and gasping while the picketed horses stamped and grunted miserably.

"Mojave Desert is some refrigerator to this!" grunted Dyke Harkin. "All th' same if it wasn't so cussed hot there'd sure be a picnic in this campaign. Four hundred U. S. troopers meanderin' a couple of hundred miles into the midst of these thousands of little Japs an' Chinese an' Mexicans! And never hearin' a yelp!"

"They yelped enough up there on the Rio Grande to carry all over little ole Mexico," chuckled Rickards. "That's when that Nullifier got over 'em and set 'em floatin' real aimless an' disregardful. They sure smeared all over the horizon!"

"And they sure yelled!" broke in Luke Summers. "I was in the old Whiskey Slide mining camp in its toughest days, and heard language, all right, but what you'd heard there was Sunday-school talk 'gainst the saints and devils those Mexicans hollered for when they were bucking each other 40 or 50 feet above the sage-brush. It was simply scand'lous, whatever that might be."

"I reckon they haven't got over it yet," grinned Harkin. "They don't seem to be dead anxious to get where we can invite 'em in for a smoke or a poker hand. This is more like a moving picture stunt than a campaign. Look at them guns—big enough to scare the gall out of a million of men, an' yet—well, you know what they are!"

He waved his cigarette over toward the battery of six guns, appalling in their monstrous length and diameter. As large as 16-inch turret guns, they were mounted on ordinary wagon gears, and although on the march a dozen mules were hitched to each, it was to emphasize the size. Four would have been ample even on bad grades, for they were but wooden counterfeits—all except one.

A laugh broke from the party. "Bob-tailed flushes—every one of 'em!" grunted Summers. "But they've sure got the enemy guessing if their aero scouts have sized 'em up."

"There's one of 'em 'll do something to 'em besides guessing!" grunted Rickards. "That aluminum gun there that looks like the others, only it's different. Four men can dismount that easy an' carry it up any trail that a mule could scramble over. That fellow Cawthorne's had a hand in that!"

"Well, say! Who's this Cawthorne, anyway?" asked Stull.

"He's the son of his father," grunted Rickards.

Stull glared, spat viciously at a cactus, and growled:

"You've got me! I pass! Now, who's his father?"

"Dunno. He's dead! But he was the high monkey-monk of the biggest electric factory in our ole United States; and his son's following in his footsteps—more or less."

"Ugh! An inventor, eh?"

"Nix! He's not an inventor himself, but he antes-up for 'em. He built those submarines that put all the Jap-Chinese battleships to sleep up San Francisco way. Likewise an' also, he got up those Gravitation Nullifiers we've been tellin' you about. An' when you hear that he's got a hand in one of those big four-flush guns, you can look for some play."

From out of the rosy glare of the setting sun a scout aeroplane came over the camp and circled slowly round.

"Signaling the Colonel!" exclaimed Harkin, and a moment later a bugle sounded. It was not a regulation army call; the men recognized it as the special call for Captain Cawthorne's squad, and instantly every man in the camp was on his feet gazing at the group of men who rushed to one of the big guns.

Captain Cawthorne and Lieutenant Sandhurst strode over to the great aluminum tube. A command was given and the muzzle of the gun went up in the air until it pointed to the zenith. Then it was lowered and pointed to the horizon.

"Circle it!" commanded Cawthorne.

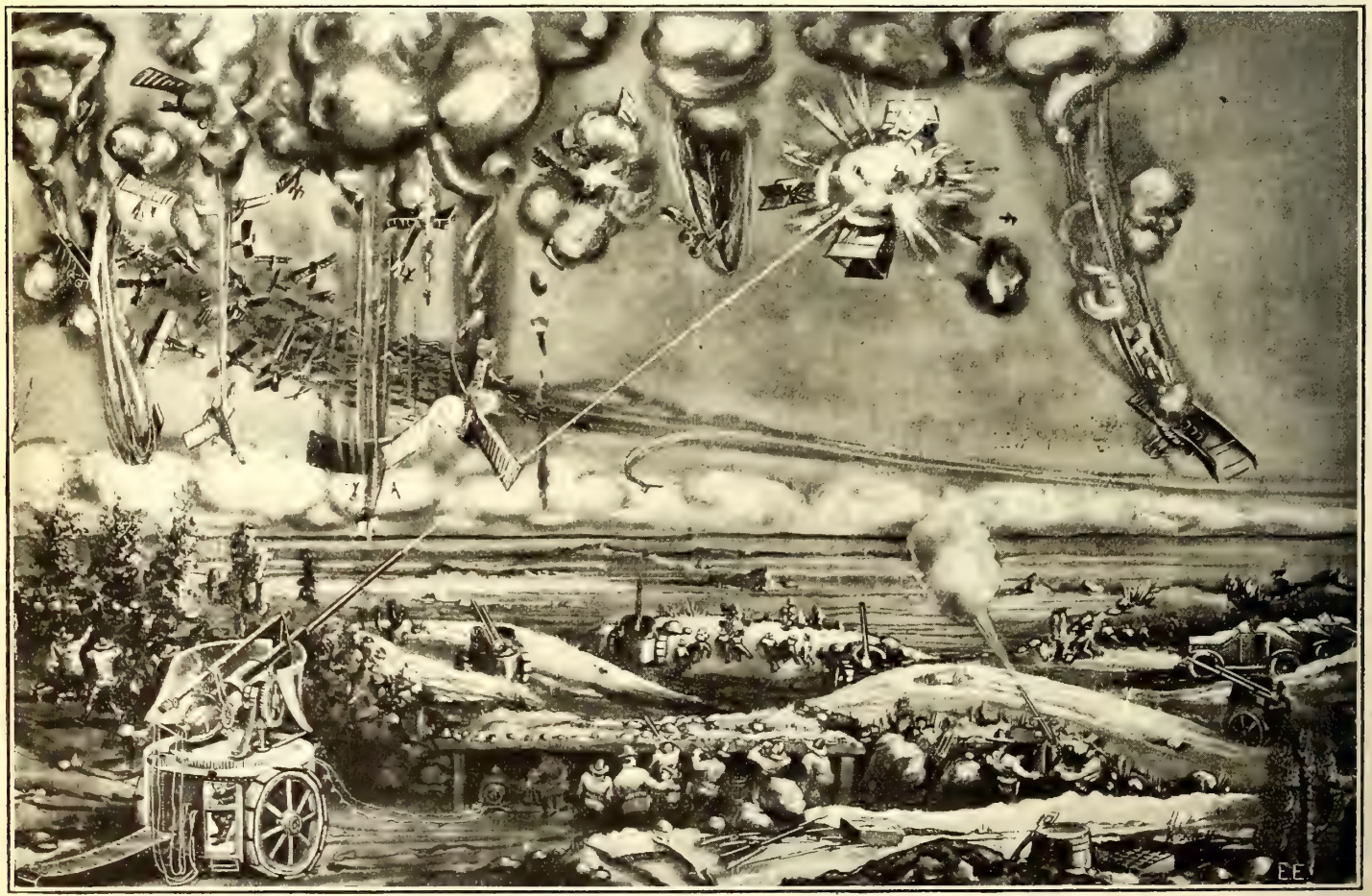
The great tube swept swiftly round in a complete circle, and Cawthorne murmured: "In fine control, Lieutenant, and just in time. Here they come!"

Southward was the buzz as of the steady hum of many factory wheels, but nothing could be seen.

"The connections with the producer are all right, Kilroth?"

"All right, Captain. I've turned on the radio selenite plates and the accumulator."

Then in the south appeared a blur like nebulae of a gray cloud. The burr increased and in less than a minute the enemy reported by the scout aero became clearly



"Captain Cawthorne swung the tube across the sky . . . . . and that ray—the marvelous 'Poniatowski ray'—fired every bomb, every gun and every holstered revolver among them."

IF you are at all interested in the wonders of modern science, you will surely appreciate this remarkable story by Mr. Stratton. The Poniatowski Ray, which proves to be the medium whereby the American army annihilates an entire hostile aerial squadron, is believed by many to be a future scientific possibility and one that may become a practical device for military uses within a shorter time than one may suspect. Briefly considered, the Poniatowski Ray may be visualized to consist of a powerful ionized stream of electrons which can be shot forth from a proper directing orifice or tube, in a practically parallel stream, vibrating at millions of cycles a second and capable of detonating any kind of explosive, no matter how well it is protected by external casings. The latest scientific theories advanced endeavor to prove that there really is no solid matter existent, but that what we term matter is made up of electrons electrically related or bonded to each other under certain conditions which obtain in nature. If the key to this situation is discovered, as for instance, is exemplified in the Poniatowski Ray, then indeed the war of the future will be a catastrophous world-wide event unbelievable and we might almost say unimaginable.

visible—a great, scattered mass of aeroplanes.

"They're planning to clean us up," grinned Cawthorne. "I suppose every one of them carries bombs, but they little dream who's going to give the order to fire 'em."

"They're three or four miles off yet," muttered the Lieutenant. His binoculars were at his eyes, and after a steady look he said: "There must be three or four score of them, Captain."

"Put that rapid-fire gun into action!" commanded Cawthorne. "Never mind the aim; just make noise." Then he sprang to the sighting instrument of the projecting tube and pointed it at the approaching aeros.

"Switch in, Kilroth!" he exclaimed.

Instantly a tiny ray of light, so nearly as blue as the sky as to be barely discernible, shot from the tube, and from the aero fleet, a mile away and nearly a mile above the earth, came lightning flashes of flame with terrific crashes, drowning out the continuous rattle of the rapid-fire gun. Cawthorne swung the tube across the sky with some little deviation in the elevation, and that ray—the marvelous *Poniatowski Ray*—fired every bomb, every gun and every holstered revolver among them. The gasoline tanks went as instantly, wrecking the aeroplanes. Even the few which had not been caught in the first sweep of the ray and had circled round or to one side, were caught by the swift, well-judged movement of the projector. Within one minute that fleet of over 80 aeroplanes had come to the earth, most of them smashed to splinters by their own explosions, the others crippled by the near-by concussions or collisions.

"Good work!" exclaimed the Lieutenant. "We've put every one of them out of commission in less than half a minute. Hello! What's that mean?"

A shrill bugle call rang out, "Saddle-up," and all the men of the command were instantly on the jump. Colonel Rutherford, who was in general command of the expedition, strode up to Cawthorne.

"That's simply miraculous work, Captain; but it breaks up this night's camp. We're 40 miles yet from the coast, and we must cover that before the enemy has time to figure out how to meet this astounding attack. One plane got away and will report it all."

"I think they'll lay it all to that rapid-fire gun, Colonel. That ray was scarcely visible to anyone not looking especially for it, and of course they don't know of the existence of such a thing."

"Possibly so, sir. But I wish it hadn't been necessary to use it at all until we could open up on their vessels. Well, we'll advance now, so as to make our main attack to-morrow night."

An hour later, as the officers were butting their armored car through the sagebrush and talking over the instantaneous demolition of the aero fleet, Lieutenant Baxter asked:

"Who is this man Poniatowski who discovered, or invented, that ray, Captain?"

"Discovery is right," smiled Cawthorne, "although I'm sure from what he told me that he used up as much time and intense thought and study in reaching that discovery as if it had been the most intricate invention. He's a Pole and was a man of property over there, and very scientific attainments, but after he had discovered that extraordinary arc—and in spite of his efforts to keep it secret—his Government, with its spies at every man's elbow, heard about it and demanded a full description of its principles and application. They had even ordered his arrest, when a friend gave him a pointer. He smashed his apparatus in his home workshop, secured the gram of radium in which all his wealth—nearly a hundred thousand dollars—was tied up, and fled inside of an hour. He had thrilling adventures and hair-breadth escapes, but reached a port and got passage to this country. But in that struggle for freedom—for life—he lost that radium and landed in New York in poverty. He got a job as laborer in our shops, and I heard of him through one of the foremen and got in touch with him. When he found that I was surely a friend he told me about the arc. That's how it is."

"And you went ahead and developed it?"

"I helped in the only way I can help with such things—by money. I sent him to my experimental shop at my country home, bought another gram of radium and put everything at his disposal."

"And this is the first time the ray has ever been put to use?"

"Absolutely! Poniatowski is no lover of warfare. The fearful calamities of it in his own country made him determined to put no fresh weapon in the oppressors' hands; but, all the same, he sees plainly that, used for defense or repression, it will stop warfare with one-quarter or one-tenth of the sacrifices of life and property of the most deadly up-to-date implements now in use, for it puts the fighting all on one side. It puts the enemy's forces—land or naval—absolutely under the control of our officers, as you will see to-morrow."

"I've seen it to-night!" muttered the Lieutenant grimly. Then, after a pause: "I presume then, Captain, that the projector we have with us is the only one in existence?"

"No; there's another. I built this one at my own expense and offered it to the Government. When they decided on this expedition they planned to have another for a relief machine. Then a dispute came up as to which branch of the service the projectors properly belonged to—the army or navy—and they discussed that for three weeks, and settled it by ordering one projector to be placed on a cruiser and sent round to the Gulf of California to Admiral Roberts' fleet, and the other one to be sent overland to attack the Allies' headquarters at Zapata. You see, Admiral Roberts cannot take his ships into the bay because those Japs have mined and netted the entrance thoroughly, and their submarines prevent all efforts to clear the channel; but if they put that projector in action it will explode every mine and every submarine within reach of the ray, and we've tested that up to six miles."

"What! That marvelous ray can operate under water? Can find and explode the hidden mines?"

"The tests have shown that thoroughly, Lieutenant."

The end of that forced night march took them within 16 miles of Zapata, on the shore of the Cisneros Bay in the Gulf of California. Here was the supply base of the allied Mexicans, Japs and Chinese, the latter two furnishing from their great fleet of transports and supply vessels the munitions which the Mexicans were deficient in, their supply from the United States being, of course, shut off.

A scout aero came in and reported that the enemy had cut a trench five miles from where Rutherford's command was, and had an immense body of men excavating a second trench between the first and Zapata. As that report was made, firing from the first trench commenced, and shells began to drop, although the range and the aim were inaccurate.

"We've got them guessing pretty bad, if not scared," laughed Cawthorne. "Digging trenches to protect 20,000 men from 400! Those Gravitation Nullifiers aren't forgotten yet, and the mysterious explosions of their aero fleet haven't quieted their nerves any."

"Send an order back to our aeroplanes to advance immediately with the two Gravitation Nullifiers!" commanded the Colonel.

The crews of the aeros were bivouacing five miles in the rear, but in 10 minutes they were flying swiftly over the command, one of them coming to the ground to pick up Cawthorne.

From the first trench came volleys of shot and shell, but the aeros had risen 3,500 feet, and no missile reached them. Then the little bullet-like metallic *attractors* were scattered from the escort aeros upon the trench below and the Gravitation Nullifiers Nos. 3 and 4 went into action.

The gravitation of everything below them instantly disappeared. Heavy guns, being fired as the Nullifier influence reached them, recoiled as if they had themselves been struck by a 10 times larger shot than they had fired. Japs and Chinese floated out of the trench clutching frantically at each other or at the wafting cannon or small arms with which they were mixed.

So on to the second trench, where men with picks and shovels found their weight gone; where boulders which two men with difficulty tossed out of the trench suddenly lost the earth's attraction and drifted away in utter aimlessness. Mules hitched to ammunition and supply wagons, frenzied by the astounding conglomerate of men, weapons and rocks which floated against them, pranced into the air and failed to regain any footing. The demoralization was complete.

But from a relief trench guard which was

(*Continued on page* 518.)

Baron Münchhausen's New Scientific Adventures

By Hugo Gernsback

Thought Transmission On Mars

I WAS sitting in front of my radio set lost in thought. Yes, perhaps I was dreaming while I blew big gray clouds in the air; you are apt to do so if you are smoking your favorite *Nargileh*—the Turkish water pipe. I personally like the Nargileh, where the smoke must first pass through the water, there to be purified before it enters your mouth, cool and fragrant. If you are a pipe smoker you must get acquainted with the Nargileh by all means, there is nothing quite like it. I am so enthused about it that I would like nothing better than telling you how to make one, but—alas—I am supposed to report Münchhausen's doings; am supposed to be writing fiction, *scientifiction,* to be correct, and not "how-to-make-it" "dope!" The editor says he can get all the contributions he wants for that department, so he doesn't need mine. Between you and I, I like the "how-to-make-it-stuff" better myself. Mars, to be sure, is all right, but we're simply not educated enough to understand all this advanced Martian business. If I could only get a message to Münchhausen and ask him what kind of "dope" is published in the Martian *Electrical Experimenter* in their "How-to-make-it" department! As our venerable friend, Thomas Reed, is wont to say: "Take it from an old bug, that would be a treat, eh, buglets!"

I was still dreaming, lost completely in a blue smoke cloud when my electric chime, controlled by the Western Union clock, which gets the exact time hourly from the Naval Observatory, commenced to sound the eleventh hour in its sonorous, vibrant voice.

At the stroke of eleven—my headset had been already clamped over my ears—the familiar high whistling sound sung in my ears once more. Punctually, as usual, Münchhausen "called."

"Same, good old Münchhausen," I said to myself, and I listened expectantly for that dear, croaking sepulchral voice. Instead of this, however, he had a little surprise for me. He did not speak; instead, without warning, there suddenly broke into my ears the most amazing music a mortal has ever heard. The sound was so loud that I was actually forced to take the 'phones from my head and place them on the table, and I had to go to the far end of my laboratory in order to hear the music at its best.

And to think that I was listening to music which had originated on Mars 60 million miles away! It was almost unbelievable! However, there it was, filling up the entire room with the most delightful music, impossible to describe. Sometimes it sounded like an immense orchestra, then again like a *celesta* instrument. At other times the music sounded like a 'cello mixed with a flute, immediately to change into a mixture of an oboe and a cornet. In between there was a sound like human singing, but altogether different in quality and volume. Moreover, all sounds were sustained, never to break off sharply; and the music from one instrument seemed to melt into that of another without the slightest break. Thus imagine, if you can, that you are listening to a violin which gradually, in a most harmonious manner, changes into a cornet without a break! What I heard is absolutely impossible to describe adequately, for you can't describe music on paper. I can only say that I had never been stirred so deeply by music in my life, and I have listened to exquisite music in my days.

For five minutes or more I listened entranced, when the music gradually died down to a plaintive, almost crying, sound which almost brought tears to my eyes. When the "concert" was over I returned to the 'phones and I had hardly adjusted them when Münchhausen spoke: "Good evening, my dear Alier, how is old Mother Earth and yourself to-night? Sorry you can't tell me, at any rate I trust all is well! I hope you enjoyed my little musicale, there has never been *such* music on earth, to my knowledge. Too bad the telegraphone wire to the moon is so short, otherwise I would have given you a longer program. At any rate, I am certain you liked my little concert. Of course, now that you have heard Martian music you would like to know how it is produced. If I were not so far famed for my veracity I should certainly run the risk of being called something less well sounding than a story teller, but I know you will not question my statements. The undisputable facts are that the music which you just heard was produced from a solid transparent *Tos* rod, about ¼ inch thick and almost 8 feet high. At each end of this rod there is a coil which looks like a big terrestrial magnet coil. It has, however, about 14 distinct



"* * * * * the Ruler of the Planet Mars Was 'Reading' His Morning Correspondence."

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and separate windings. The ends of these windings go to a sort of switchboard which has a triple keyboard like an organ, and both coils are connected to this organ-like instrument. By depressing a key a certain pulsating current is sent through one of the coils. This in turn sets up Eddy currents in the Tos rod, which is, of course, conductive. These stresses in the rod set up vibrations and cause the rod to swing like a piano string—sound is the result. By using different frequencies different sounds are produced. When both coils are operated at the same time interferences take place within the rod, causing the sound to change in its quality. Thus by operating the two coils while changing the current intensity and by using different amplitudes, most every imaginable as well as unimaginable sound can be obtained. It is thus easy to imitate a cornet or a xylophone in their true musical values. Nor is this all, for the rod can be made to sing and trill, and it can be made to actually speak words; a good player is able to imitate the spoken or the singing voice of any living Martian equally as well as a lifeless, black phonograph disc on earth, can be made to sing the most difficult aria.

Nor does the wonder stop here. By using a sufficient amount of power the sounds can be intensified to such a degree that music emanating from a Tos rod can be heard plainly over a distance of 10 miles. Indeed, all outdoor concerts on Mars are given by means of a single Tos rod. In only one case have I seen two rods being operated simultaneously. The effect in this instance was overwhelming; it was like listening to a thousand-man orchestra and to a dozen tenors all going at one time.

But this is not all. You know that if a rod is vibrated at a sufficient frequency it will sound a certain note. The faster it vibrates the higher the note will be. If we keep on increasing the speed or vibration we finally arrive at a stage where the note is so high that the human ear is no longer capable of hearing it. If we keep on increasing the frequency, higher and higher, a stage is finally reached where the rod sends out waves that have the velocity of light and electricity—186,000 miles a second. This, of course, is well known to your physicists on earth.

Now, then, it is this principle that the Martians make use of in supplying the music loving people of Mars with wireless concerts. The operation is simple indeed.

Not far from the equator of the planet a central music plant is operated by a single Martian, who, of course, is a musical genius. He operates one of the organ-like instruments of which I spoke before. The "plant" comprises besides the instrument, two Tos rods each 20 feet high. These rods work exactly as the ones just described, except that they are operated at an enormous frequency. I have stood in front of them while they were operating, so close, in fact, that I could have touched both rods with my hands. However, my ears detected not the slightest sound. But, incredible as it seems, millions of Martians were listening to the wonderful music at that minute, produced by these same rods, *but not with their ears.* They were listening with their brains!

I told you a few days ago, how, when we first landed on Mars, we had been amazed to "hear" snatches of a wonderful music inside of our heads. What we had been hearing was the wireless music originating from these two Tos rods some 2,000 miles distant! Of course, wireless music is nothing new; the sounds of voices and music having been wafted over thousands of miles on earth already, but your scientists still require huge aerial wires with which to catch the waves. And these waves are, of course, not audible themselves to our ears. You are still using a variety of coils, detectors, telephone receivers and

OUR scientists of to-day as a rule ridicule any attempt of thought transmission and not without good reason, for there does not seem to exist any authentic case on record where thoughts have actually been transmitted freely between two individuals. But, in view of the fact that during the last 20 years we have learned how to transmit wireless impulses through the ether without the use of intervening wires, is it not possible to conceive that given sufficiently sensitive apparatus we will some day find it possible to transmit our thoughts through free space? Baron Münchhausen throws a new light upon this fascinating problem. We are confident that you will enjoy this instalment.

what not in order to translate these wireless waves into sound waves in order that your ear may hear them.

Not so on Mars. Every Martian is required, for reasons which you will understand presently, to wear a peculiar soft metallic cap. From the back of the latter a thin metallic cable runs down the Martian's back and is fastened there to his metallic coat. All Martian clothing, as well as footgear, is invariably of metallic weave. Now as all pavements and all flooring, carpets, as well as rugs, are metallic on Mars, for reasons which will be apparent to you later, a metallic connection with the earth or "ground" is always effected.

The metallic cable of which I just spoke does not make contact with the cap itself, but it is insulated therefrom. It connects, however, with a small reddish metallic plate about the size of an American silver dollar. This plate in turn, by means of a flat spring, presses against the temple of the wearer; the cap itself holds the plate in place. A similar plate presses against the other temple, but this plate, unlike the other, is connected metallicly to the cap itself. From this description you will gather that the metallic cap performs the function of a wireless aerial, while the metallic clothing forms the ground. The two reddish plates pressing against the bare temples are made of two metals unknown on earth, and the metals are distributed over the surface of the plate in honeycomb fashion without touching each other. Now if the two plates are pressed against the temples and when wireless waves are passing through them, the waves are translated into vibrations of a certain frequency. It has been found that if these vibrations reach the conscious sense of hearing which is located in the *Temporal Lobe* of the brain, sounds can be impressed upon the brain without requiring the ear and its auditory nerve. In other words, the sound is "heard" directly within the brain without the agency of the ear's mechanism.

If this should be somewhat hazy to you a homely (though inaccurate) illustration will not be amiss here. At first blush one would think that the ear is absolutely essential for hearing, but this is not the case. Try the following simple experiment: Stop up both your ears as tightly as possible with cotton so that you will not hear a sound from outside. If you are partly deaf—and I trust you are not—all the better for the experiment. Place a darning needle between your teeth by biting on it hard and take care that your lips do not touch the needle. The needle itself should project about 1 inch from your mouth. Now operate an ordinary disc phonograph and with care press down upon the record with the needle's point held at the same angle as the reproducer's needle is held ordinarily. Your whole brain will be filled immediately with music, exceedingly loud and clear. Of course, in this case you still hear with your ear's mechanism, the sound vibrations being carried to the eardrum through the bones of the head; but it is interesting to note that if a truly deaf person tries the experiment he will be enabled to "sense" the sounds, although not perfectly.

Of course, the function of the Martian apparatus is based on an entirely different principle, and the above experiment is only cited by way of comparison.

It goes without saying that these little red honeycombed plates, pressing against the temples are wonderfully sensitive to etheric waves; in that they exceed enormously the most sensitive wireless detector ever invented by your scientists. But not only do these wonderful temple plates serve to bring distant music to the Martian's brain, but they still have a more important function. The fact was already mentioned to you how we first made our acquaintance with thought transmission and how we found it impossible to transfer thoughts without the caps being on our heads.

The act of thinking, as we know it and as has been understood on earth for a long time, is merely the action of certain nerves stimulating certain brain centers. The harder we think the stronger the stimulation. This stimulation in turn sets up an undulatory motion in the effected brain cells, with the result that these cells must of necessity vibrate like a piano wire. But anything that vibrates—no matter what the frequency—must set up waves. Thus we come to the conclusion that the act of thinking must set up certain waves. Now if we can find a medium by which it is possible to detect these waves it becomes as simple a matter of transmitting the thought waves as any other wave.

The medium of detecting these "brain-waves" is found in the Martian temple plates, enormously sensitive to the brain's short wave lengths. But not only do these composite metal temple plates detect the "brain-waves," but they translate them directly into a longer etheric wave length, which in turn is shot out into space similar to a wireless message. While these waves are fairly strong, their intensity is not sufficient to carry them over great distances. As a matter of fact, thoughts have only been transmitted for a distance equaling about 10 terrestrial miles on Mars. And even this was exceptional, extra high sensitive apparatus being used at the time for the experiments. As a rule the Martians do not project their thoughts over 50 terrestrial yards, as the confusion and clashing of the many waves would otherwise become too great. If a number of Martians are assembled in one room they can converse very nicely by thought transmission without interfering with one another.

(*Continued on page 523.*)

How "Wireless Wiz" Welcomed the New Year

By Thomas Benson

I WAS sleepy that night as I sat "listening in" at my wireless to N.A.A. shooting code stuff, and it seemed a sort of dream when about 11 o'clock I heard the "Wiz" break in. His spark note rose rapidly as the rotary gap picked up, and he began to rattle the ether with my call. I O. K.'d him and took down: "Say, old man, I just finished doping out a cracker-jack party for New Year's; come over to-morrow and help me install the junk, will you?"

"Sure!!"—and my spark seemed to wink at me as much as to say: "Some party, fellow," as I pounded the key in reply. "I was wondering why you called so late," I added.

"Oh, I had some battle getting all this arranged, but it will be worth it; now don't forget, come over early!" His code was shaky in spots, and I could imagine him laughing to himself as he handled the lightning, for I knew the "Wiz" of old; the "Wireless Wizard" the neighbors called him.

* * * * * * * *

"Oh! Tom, I'm getting frightened," whispered a trembling voice in my ear as the eventful evening came and we were approaching the Wizard's home. "I'm really afraid of Jim and the tricks he plays on us."

"Too late to think of that, girlie," I replied, reassured by my knowledge of the surprises awaiting us, and I held her the least bit tighter and told her to keep her nerve up, for the male of the species is always courageous when he knows what's coming off!

We mounted the steps and rang the bell. Suddenly, as if by magic, there appeared in letters of fire on the door: "ENTER, YE OF BOLD HEART." Then slowly and mysteriously it swung open.

With a much-scared girl on my arm, I walked into the hall. It was a masked party, and the "Wiz" stepped forward, garbed as Satan, to meet us; and as he led me up to the cloakroom I noted that he seemed to be a living flame, for he was glowing like fire. Most of the others were already there, and it was a great sight to see a *bearded pirate* discussing the heterodyne receiver with *George Washington*, a *straw-chewing farmer* showing the latest fancy steps to an *African chieftain*.

After removing my coat and hat and standing forth as a Spanish bull fighter, I looked around for the "Wiz," who then led us to the Altar of Mystery, in the Chapel of Spirit Worship.

That room was certainly "classy," with its cornshocks, which stood around it on a floor that shone like glass. Imitation logs were arranged along the wall for seats, and the ceiling was draped in a flimsy gray cloth, through which glimmered the light from numerous concealed red and yellow electric bulbs. The girls waiting for the dance seemed like fairies in the dull, soft glow of this cleverly arranged grotto.

A piano started to play somewhere, and as the dancers swayed to the sound of the latest music the notes seemed to come from nowhere in particular. At times it seemed as though the piano was in the basement; at others overhead, in one corner, then another, and everywhere at once.

It was a smiling crowd that retired to the rustic seats after the music stopped, and they waited with unconcealed expectation for the next move. I was watching the silver lemonade pitcher that was tempting me, but I knew better than to attempt to drink any. An unsuspecting guest finally strolled over and seized the ladle. "Ouch! Wow!" and he staggered back 'mid the laughter of the rest. He decided then that he'd forego the lemonade.

The "Wiz" then dragged a tub of water to the middle of the room and tossed in a couple of apples, and the girls started to bob for them. The apples appeared to possess real life, for when approached they would suddenly sink to the bottom only to fly to the surface again. At times they would spin rapidly. The astonishment occasioned by their antics was shared in by all. Then the music started again and the tub was removed as the dancers glided away.

Next the "Wiz" stepped to the center of the room with a hand full of fans and a large balloon. He blew a whistle and instantly the lights were extinguished, and it was a wonderful sight as he stood there with the fans and balloon glowing in the light from the geissler tubes that shed their variegated colors about us.

Two hoops glowed on the walls at both ends of the room and the "Wiz" handed



". . . . . At the Last Stroke of Twelve Bedlam Broke Loose! A Fire Gong Started to Ring, Whistles Were Blowing, and the Centre-Piece Exploded."

the fans around and started a game of aero tennis. The party were divided into two teams and each endeavored to blow the balloon through their opponent's hoop. The game was getting exciting with the score tied, when supper was announced.

The doors were thrown open and the guests gaily tripped into the dining room. Here the "Wiz" had quite outdone himself. The table was decorated with miniature pumpkin heads, electrically lighted, and geissler tubes glowed at every plate. The place cards gave forth a weird phosphorescent glow.

The feast went gaily on without incident; as a lull before the storm. Nothing happened till a clock struck twelve.

At the last stroke bedlam broke loose! A fire gong started to ring, the lights went out, whistles were blowing, the centerpiece exploded—throwing the flowers in all directions. Red and green lights blazed forth in all corners of the room.

The figures "1916" stood out in relief on the shirt bosom of the "Wiz."

Then all was quiet. Suddenly mysterious rappings began to be heard, which seemed to be coming from the table. "Hark," muttered a sepulchral voice, "I, the Spirit of the NEW YEAR am here to do your bidding. I am ready to answer your questions."

One after another we all asked questions, the answers following immediately, and they were tinged with not a little sarcasm that kept the crowd in roars of laughter. I smiled to myself as I noticed the strained look on the Wizard's face as he talked under his breath. He had a microphone fastened to his *chest*, and was answering the questions as fast as they came.

Tiring of this we returned to the parlor, where the music had started again.

"Now," announced the "Wiz" amid many Ha! Ha's! and Tee-Hee's! on the part of the girls, "I am going to show each lady present her future husband," and he led them one at a time into a small room decorated like a cave. In the center burned a charcoal brazier on which he tossed dead leaves, a little incense and a hair from the girl's head. He stood over this muttering incantations. Slowly but surely a face took form in the vapor arising from the fire.

After each overawed, shivering girl had seen her future mate the music struck up "Home, Sweet Home," and the guests prepared to leave.

It was a merry crowd that prepared to leave the "Wiz" that evening, and as the guests were passing out the front door a mysterious gust of air blew their hats off and sent them helter-skelter down the street after them.

After the adieus were spoken and as they started home they were enveloped in a flood of white light from the Wizard's powerful electric searchlight mounted on the roof, and I can still see them as they disappeared from sight with their varicolored suits and the tinkle of bells on their costumes.

I had stayed to say a few words to the "Wiz," and as he came into the room he sank into a chair with a sigh, looking tired and as glum as an owl.

"What's the matter, Jim?" I asked, "we had some time to-night, cheer up!"

He looked at me in such a pitying way I couldn't help smiling.

"Yes," said he, "but do you realize it is a whole year till next New Years. I'm going to bed. Good night!!"

THE MODUS OPERANDI.

It was several days later before I saw the "Wiz," surrounded by a crowd of youths at the headquarters of the *Gee-Whiz Wireless Association*. They were firing questions right and left and he was at his wits' end to answer them. "Go easy boys," he fairly shouted. "I will send you all a blue-print of how it was done; but meanwhile you can look over this hook-up," and he handed them a sheet similar to the drawing we find here. "Yes, sir, but explain!" they replied simultaneously, and the "Wiz" tackled the job without blinking an eyelash.

"It was all very easy," he went on. "The music was supplied by a phonograph in the basement and four loud-talking telephone receivers did the rest. These were connected up to a commutator and a motor so that the current could be switched from one to the other automatically, and that explains why the music seemed to change its source continuously. I had a 4-inch spark coil, which supplied the high tension current for the lemonade pitcher and the geissler tubes. The apples in the tub contained short steel cylinders stuck in them; by means of a switch in the corner and a large electro-magnet under the floor I was able to make the apples behave in a mystifying manner.

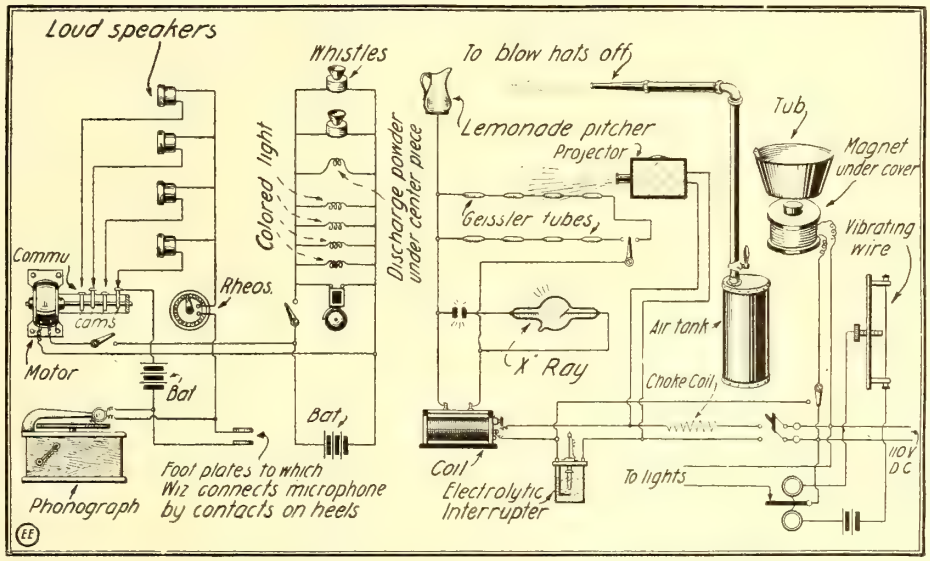
"To extinguish the lights when I blew the whistle I had a tightly strung steel wire tuned to the pitch of my whistle which vibrated, due to the sound waves. This made contact with a fine adjusting screw and operated a relay, thereby extinguishing the lights. As to seeing the faces in the smoke arising from the brazier, that was a cinch. I had a parlor projector concealed behind the draperies and I had a common photograph which was thrown on the smoke, which served as the screen. The girl who saw the picture unconsciously picked out its resemblance to some particular friend of hers and practically kidded herself that he was her future husband, what! The red and green lights around the dining room were easily provided for, as you can well imagine.

"I had a fine wire imbedded in the powder and on closing the switch it was ignited on the table centerpiece. The slight, harmless explosion sent the flowers in all directions and a gong and two whistles completed the noise manufacturing equipment. A nozzle connected to my blow pipe compressed air tank served to blow your hats off as you were going out the door."

"Yes, sir," a wise one among them asked, "but explain that lettering on the front door." "Sodium Tungstate," was the curt reply, "and an X-ray tube concealed on the ceiling served to make a glow when I closed the proper switch. I also used this chemical to write the place cards; to cover the balloon and fans, and I furthermore had quite a large amount of it smeared on my costume.

"The figures '1916' on my shirt front were easily arranged by cutting them out of thick black cloth and securing them to the inside of the celluloid bosom by a little glue. A couple of battery lamps placed inside the shirt and fed from a flashlight battery in my pocket did the trick."

"Oh, yes, it's as clear as mud," another one exclaimed, "but how in the name of the seven stars of the constellation were those questions answered by that supposed Spirit?" "Don't you read the *Electrical Experimenter?*" answered the "Wiz." "I got the idea from that article where they described how the aviators communicate by means of microphones strapped on their chests. So I had a delicate telephone transmitter fastened on my chest and by means of two brass plates on my heels I made connection to the loud-talking telephone circuit," and with a parting smile he left them to puzzle out the other details for themselves.



Diagrammatic Lay-Out of the Electrical Novelties Used for New Year's Party by the "Wireless Wiz."

BIRDSBORO, PA., BOY SCOUTS WORK WIRELESS.

Finishing the week of life outdoors, as required by the rules of the organization, the Birdsboro, Pa., Boy Scouts held the last camp of the year at Neiman's Pond, near Laurel Hill Canal locks.

There was a good attendance and Scout Master Charles Brooke, who had charge of the lads, was well pleased with their conduct and the work they did in conformity with the organization regulations.

The camp was situated upon a hilltop, about one-half mile from the canal, the location being selected for the purpose of erecting a high wireless aerial. This was a new and the most interesting feature of the camp. In an hour after reaching the camp site the wireless corps was in communication with Pottstown, League Island and Washington, D. C., and several amateur stations in these places held conversations with Scout Master Brooke, who is a competent operator. The field set of equipment used was found especially serviceable, light and easily portable, also extremely efficient, loud and distinct.

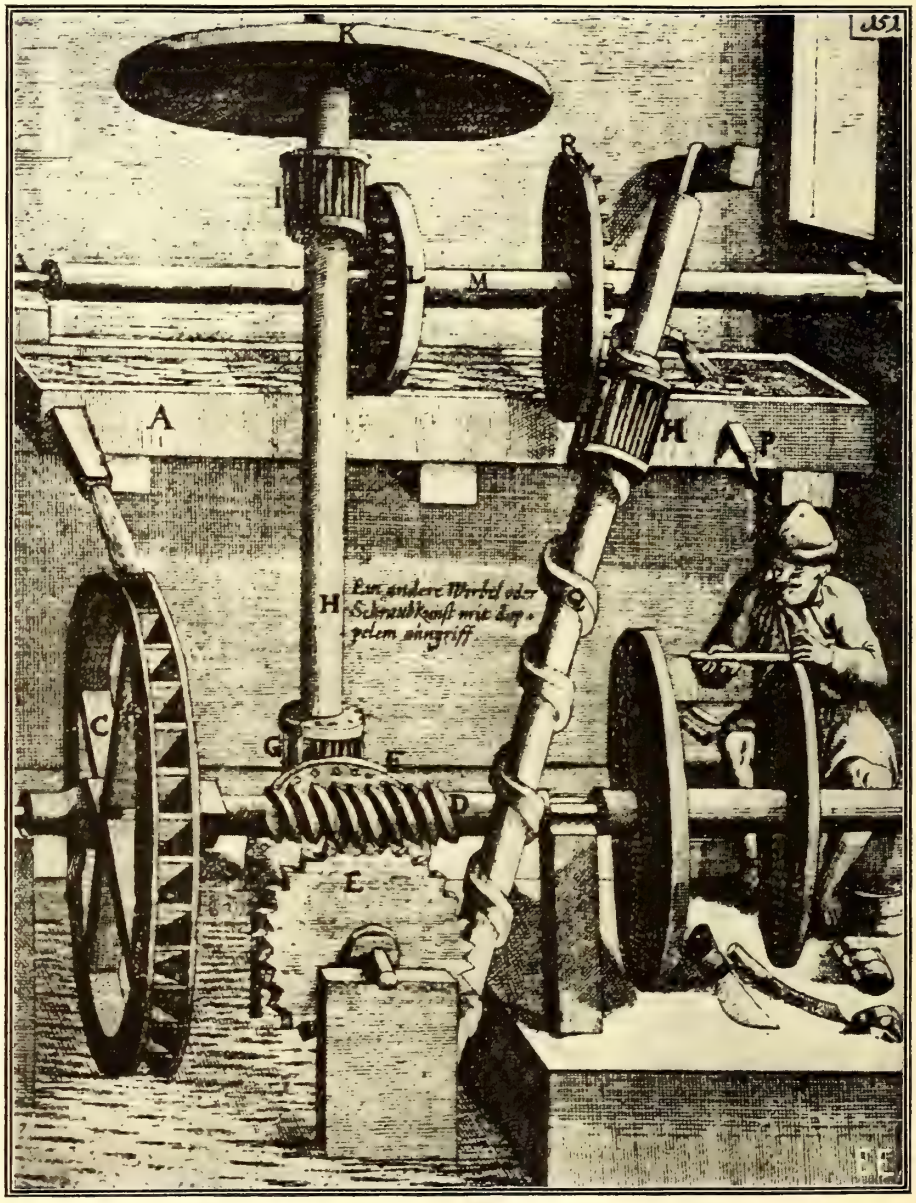
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Perpetual Motion, the Folly of the Ages

By H. Winfield Secor, E.E.

Untold Numbers of Inventors and Even Scientists Have in Years Past, and at the Present Time, Devoted a Vast Amount of Study to the Perfection of a Perpetual Motion Machine—The Problem Remains Unsolved, However, to This Day

PERPETUAL motion is the will-o'-the-wisp that has occupied many brilliant minds in the centuries past, as well as at the present time, and, while we of this age are not entitled, perhaps, to say definitely that all such ideas are absolute folly and baseless from a strictly scientific and physical standpoint, it is pretty thoroughly understood by all well-schooled engineers and inventors of today that there is practically no such thing as *perpetual motion*, in the general sense of the word. Perpetual motion is a very misleading term as applied in various senses, and in treating such a subject as this the confining limits of the points involved should be thoroughly understood. Some theorists and would-be scientists will propose such ideas or phenomena as the light of the sun, ocean waves, rotation of the earth, and what not, as the embodiment of perpetual motion. However, the hundreds, and undoubtedly thousands, of more or less well-trained minds that have endeavored to solve this much-talked-of problem of perpetual motions have invariably had in mind some mechanical, electrical or other machine which, when once started in motion, would continue producing this motion indefinitely, or to the end of time. So far no machine or allied device of any description has been perfected or produced, but several quite remarkable phenomena taking place in nature will be mentioned herein which approach this much-desired goal of inventors past and present.



An old engraving illustrating a "Perpetual Motion" scheme taken from the German work, "Das Perpetuum Mobile," by Andr. Bodler.

This arrangement was supposed to work as follows: The tank of water A discharged through a nozzle on to the water wheel C. This turned the shaft and worm D, likewise the gears E, E, and also the vertical shaft H. Attached to H is a balance wheel K and a pinion I, driving gear L, shaft M and gear wheel R. The latter meshed with the pinion H (at right) secured to the hollow worm Q, thus pumping the water back into tank A. This amazing machine was claimed not only to go on forever, but also to "deliver power," as for driving the grindstone here pictured.

Many extremely amusing situations have occurred between scientists and would-be inventors of perpetual motion machines, and a few of these instances are here cited which may be of more than passing interest to those who have been or who are now thinking along this line.

One of these stories is related of how an inventor of a certain machine betook himself to a mechanical engineer for advice on same. The machine in question was supposed to multiply power and the inventor of this device maintained that if one horsepower of energy was applied to a pulley on one end of the mechanism, then 20 horsepower could be taken from a second pulley placed on the other end of the combination. The engineer asked the inventor if he believed in perpetual motion, and he replied, "Certainly not."

"Well," said the engineer, "if you use one of the 20 horsepower you claim to produce, you will have 19 horsepower left for other work, will you not?"

"Yes," replied the inventor.

"Then take one horsepower from the pulley which will deliver 20 horsepower and drive the other end of the machine requiring but one horsepower, as you mention, and you will then have perpetual motion!"

It is said that the inventor departed forthwith with without even unrolling his drawings.

Again, there is nothing wrong with trying to tap any of nature's reservoirs, but what is wrong is when we try to make 2 plus 2 equal 5 mechanically. It is a consoling fact, indeed, that we should know, as we do know, that an accountant's balance sheet is always possible for any mechanical operation. On the one side we have the money paid in, that is the horsepower available; while on the other side we have the money paid out; that is the work done and the energy wasted; the two sides must balance one with the other eventually. For a given horsepower put into a certain device or machine we are entitled to look for a strict accounting of energy expended by this machine. The final results must show so much work done plus so much wasted, avoidably or unavoidably, and the work done plus the work wasted must in every case equal the work originally put in. Also there must be no pretense made or assumed that any amount of the energy has mysteriously disappeared—in other words, there must be no allegation that the books will not balance.

The inventors of so-called perpetual motion machines have, from time immemorial, evinced a partial or total disregard of the basic laws of physics and mechanics. The term "friction," for one thing, seems to have found no place at all in their vocabulary or knowledge of science. If it had, indeed there would never have been patents issued and whole volumes written covering their early research work or, for that matter, the present-day research on such impossible appliances or machines as we feel called upon to name them in the light of our present-day knowledge of the aforementioned branches of science.

When one of these perpetual motion inventors can show us a machine that will operate absolutely *without friction* and in direct defiance of the *laws of gravity*, and, considering these terms in all their multi-

farious and multitudinous phases, in which we are compelled to apply them to all man-made devices and apparatus, then you will probably see such a machine, which will keep in operation forever.

It will probably bring out the point at issue more clearly if we consider a number

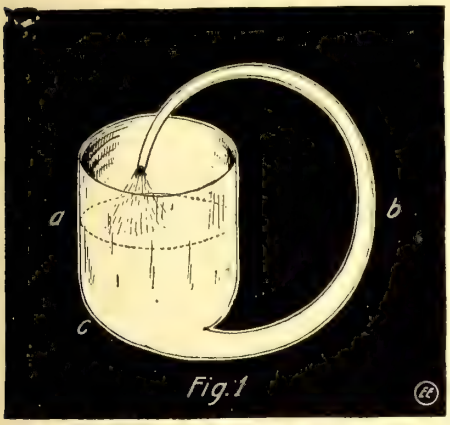


Fig. 1. In This Simple Device the Water in "a" Was Supposed to Overbalance the Smaller Column "b," Causing it to Spout Out Into "a," Ad Infinitum.

of the ingenious ways and methods called into play by the various investigators of this phenomena and consider carefully the deficiencies in same and the reasons therefor.

Referring to Fig. 1, there is observed a hydrostatic device which is supposed to keep on operating forever, and this was invented at an early date. It has been promulgated and adopted over and over again by many sanguine inventors, and it was proposed at one time by the Abbé de la Roque, of France, in 1686. The device comprises a glass vessel of the form shown in the illustration, and, as perceived, the section B is made much smaller than the portion A. When water is placed in the larger chamber A it is, on account of its greater volume and weight, supposed to easily counterbalance the small column of water in the portion B, and hence the liquid would be forced up through the restricted tube section beyond B, and thus discharged back into the bowl A. This is supposed to keep up until the water is evaporated. Needless to say, the inventor, or rather inventors of this apparently remarkable device were con-

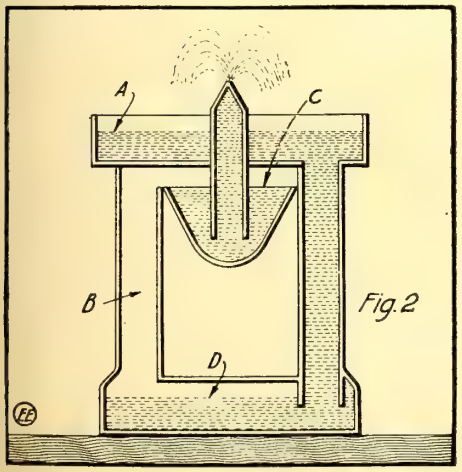


Fig. 2. Hero's Fountain, a Hydro-Static Contrivance Often Considered as a Solution to the Perpetual Motion Problem.

founded when an actual trial demonstrated beyond the shadow of a doubt that the device would not, under any conditions, operate on account of the fact that the liquid maintained an equal level in the chambers A and B in accordance with the well-known laws of hydrostatics. Simply explained, the air pressure per unit surface area remains the same, or, roughly, 15 pounds per square inch. Gravity aids in establishing equal levels in the two chambers or tubes. Reference to any book on physics will serve to clear up this matter thoroughly.

In this direction there was another form of hydrostatic perpetual motion device, known as Hero's Fountain. The sketch at Fig. 2 shows the arrangement of this device, which comprises an upper chamber, A, open to the atmosphere, which chamber is filled with water. The water also passed from this chamber down through a tube or pipe into a lower receptacle D. The pressure was supposed to be transmitted from the water in this way so as to compress the air in chamber B, and thus react on a second water basin C, and thus the liquid was supposed to be forced out of the nozzle at the top of the fountain, as the illustration shows. If such a device would work, needless to say the problem of perpetual motion would have been solved long ago, for this idea dates back hundreds of years. (If the upper basin is larger than the inner one, then the device will operate for a while.)

Electricity, owing to the fact that it has always been but very vaguely understood, even by some of those skilled to a high de-

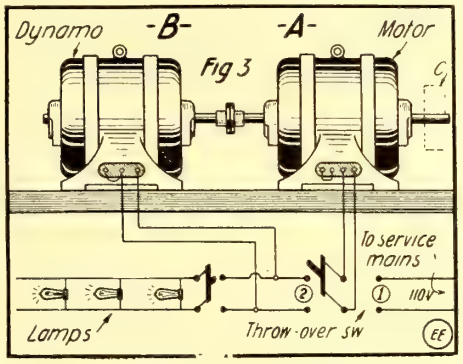


Fig. 3. An Electric Dynamo and Motor, Connected Together, Are Expected to Operate Each Other, and to Even Supply Outside Energy, by Many Amateur Electricians.

gree in the art, has caused a great many students of this branch of science to burn a vast amount of midnight oil in trying to perfect a device employing electricity in some form or other that would keep on the "go" forever.

Among amateur electricians undoubtedly one of the standard forms of this "pipe dream" is that shown at Fig. 3. This necessitates the use of a motor and dynamo connected together in some way or other so that after once starting same from some external source of energy the dynamo will generate the current for driving the motor, and, considering that they are finally interconnected, the motor will in turn drive the dynamo. Thus they will keep on working forever, ad infinitum. To the thorough electrical student this proposed scheme is, of course, absolutely fallacious and ridiculous. In accordance with the well-known law covering the conservation of energy, which states that matter or energy can never be made or destroyed, and also that it is manifestly impossible, at least in our age, to construct a machine that will operate at 100 per cent. efficiency, *without any waste of energy whatsoever,* it will be seen that it is utterly hopeless to think for one moment that such a combination can be made to operate for even a few seconds, let alone months and years, as some inventors fondly think.

As a matter of fact, and to thoroughly bring out the defaults of this arrangement, authentic data is here cited covering the actual performance of such a motor-generator set.

Let us consider that the motor used to drive the dynamo by direct coupling, which is the most efficient method of mechanically connecting the machine, is rated at five horsepower. This considers the five horsepower rating of the motor mechanically at

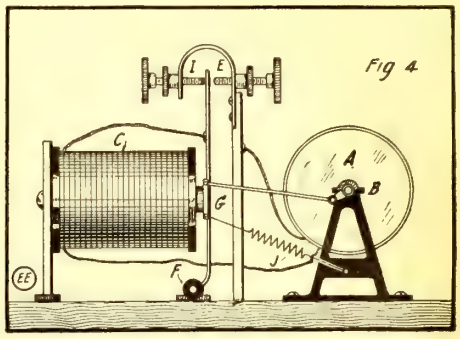


Fig. 4. Electrical Perpetual Motion Machine of an Early Vintage. A Static Generator A Excites the Magnet Coil C, Whose Circuit is Opened and Closed by Contacts E and I.

the driving pulley or shaft. From careful tests made on such machines the relation of the input of the electrical energy to the output of mechanical energy is practically 80 per cent. for this size unit. Hence, if the motor is rated at five mechanical horsepower (in accordance with the rated efficiency), then the electrical input on the motor must be 6¼ horsepower. Considering the aforementioned efficiency loss, the one horsepower is consumed in bearings, windage, copper and iron losses in the motor. There is also some over-all coupling loss in such motor generator sets, and the dynamos are never rated, in properly designed outfits, to correspond with the horsepower output of the motor. If we allow 10 per cent. difference between the mechanical horsepower developed by the motor and the dynamo input, we will then have allowable for this latter value 4.5 mechanical horsepower. Considering, now, that the dynamo has an efficiency of 80 per cent. (for the conversion of mechanical into electrical energy), then it will have an output of 4.5 horsepower times 80 per cent., or 3.6 horsepower. Recapitulating, it is now evident that the gross over-all efficiency of the motor generator set is 3.6 divided by 6.25, or 57.6 per cent.

If the dream of this perpetual motion

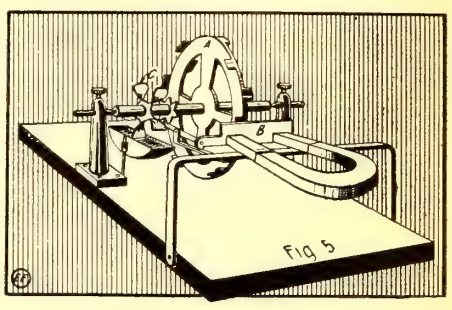


Fig. 5. Another Electrical Wonder Expected to Revolve Forever. A Magnetic Insulator Cuts On and Off the Flux from the Steel Magnet as Perceived.

scheme is to be realized, it will have to be under conditions that will allow of no loss whatsoever, even to the smallest degree; and, of course, as every well-informed electrician knows, this is out of the question. Some of the inventors and re-inventors of this scheme have even claimed that lamps

can be lighted from the dynamo, as well as driving the motor from the same source of energy, and our sketch, Fig. 3, shows this proposed innovation.

There have been thousands of mechanical devices devised to realize the perpetual motion goal, but none of them have proved successful in actual tests. It may be of interest to state that the United States Patent Office experienced no end of trouble with this class of patents and proposed patents some years back, but the annoyance became so pronounced that finally a rule was passed that a "model" of such proposed patents would have to be submitted. Needless to say that this has put a quietus on the perpetual motion dreamer, as there has never yet been submitted to the Patent Office a machine which would keep moving for any appreciable length of time, for the several mechanical and physical reasons well known to any student of the science.

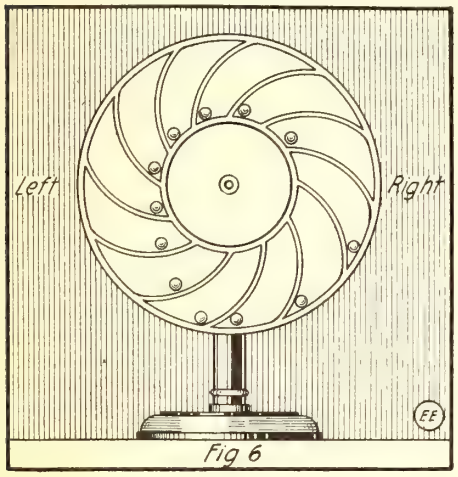


Fig. 6. The Ever-Changing Center of Gravity of the Various Balls in This Multi-Path Wheel Was Expected to Cause It to Rotate Perpetually.

For the benefit of those who have not studied the problem from a mechanical viewpoint it may be worth while to look into the cold facts of "friction." In practically all, or nearly all, of the devices of various types intended to operate forever, there has always been a very appreciable amount of friction to be overcome and which fact was apparently totally ignored in designing the machine. The friction might be very small indeed in the machine, but *it is there invariably*, and cannot be gotten rid of by any method known to us. Some have tried to realize the long-sought-for goal of 100 per cent. efficiency by utilizing devices employing a number of gears —from two to three, and sometimes a dozen or more. As machine designers well know, there is not, nor never has been, a gear train of no matter how few gears that would transmit mechanical energy in a reduced or intensified form (as regards velocity) without some loss of energy in friction and tooth slippage in the gear action. The efficiency of a small gear train may vary from 80 to 86 per cent. or more for medium velocities at the pitch line of the gear. Any machine design or mechanical engineer's handbook will give this data in lucid form, and it has been compiled from many observations and extremely careful tests conducted in laboratories of the leading universities and colleges, which are thoroughly equipped for this work.

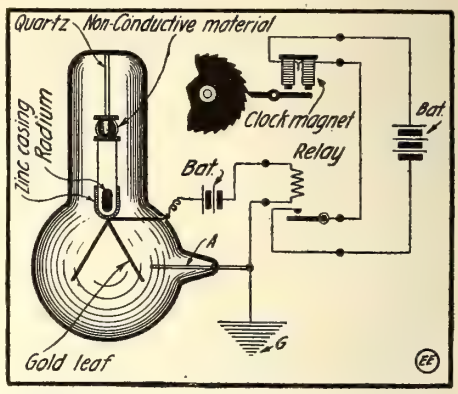


Fig. 7. The Radium Clock, Devised by Prof. Struts, Can Work for 2,500 Years, but Even That Is Not Perpetual!

Any moving objects or parts of a ma-

(*Continued on page* 514.)

Andre Marie Ampère

Born January 22, 1775. Died June 10, 1836

TO this early scientist and investigator, born at Lyons, France, in the year 1775, is due the credit of first discovering the magnetic action taking place between two separate and independent circuits carrying electric currents. He made this discovery shortly after Oersted had found that a wire carrying a current wrapped around an iron core would produce magnetism. With apparatus that was more or less limited he formulated several important laws that are still accepted as being correct in every detail.

The following are the laws discovered and formulated by Ampère:

(a) Two parallel portions of a circuit attract one another if the currents in them are flowing in the same direction, and repel one another if the currents flow in opposite directions.

This law is true whether the parallel wires form parts of two different circuits or parts of the same circuit. The separate turns of a spiral coil, when traversed by a current, attract one another because the current moves in the same direction in adjacent parts of the circuit; such a coil, therefore, contracts when a current is sent through it.

(b) Two portions of circuits crossing one another obliquely attract one another if both the currents run either toward or from the point of crossing, and repel one another if one runs to and the other from that point.

(c) When an element of a circuit exerts a force on another element of a circuit, that force always tends to urge the latter in a direction at right angles to its own direction. Thus, in the case of two parallel circuits the force of attraction or repulsion acts at right angles to the currents themselves.

(d) The force exerted between two parallel portions of circuits is proportional to the product of the strengths of the two currents, to the length of the portions, and inversely proportional to the distance between them.

From the four preceding experimental data Ampère built up an elaborate mathematical theory, assuming that, in the case of these forces acting apparently at a distance across empty space, the action took place in straight lines between two points, the total attraction being calculated as the sum of the separate attractions on all the different parts. The researches of Faraday have, however, led to other views, and we now regard the mutual attractions and repulsions of currents as being due to actions taking place in the medium which fills the space around and between the conductors.



Andre Marie Ampere, After Whom the "Ampere," Unit of Electrical Current Is Named.

Ampère, finding that solenoids act precisely as magnets, conceived that all magnets are simply collections of currents; or that around every individual molecule of a magnet an electric current is ceaselessly circulating. We know that such currents could not flow perpetually if there is resistance when electricity flows from one molecule to another. As we know nothing about the interior of molecules themselves, we cannot assert that Ampère's supposition is impossible. Since a whirlpool of electricity acts like a magnet, there seems indeed reason to think that magnets may be merely made up of rotating portions of electrified matter.

It is worthy of note that Ampère as a boy had very few home advantages, yet by industry and study he managed to acquire a very comprehensive education. When but twenty-six years old the publication of a remarkable series of mathematical papers secured for him the chair of mathematics in the Ecole Polytechnique, of Paris. His knowledge of mathematics was profound and he published a series of memoirs on the mathematical theories of the electro-magnet. This was a task almost beyond human powers at that time, and by successfully accomplishing same he was honored by most of the scientific societies of Europe.

His last work, "Philosophy of the Sciences," showed him to be much less happy in the metaphysical than in his physical and analytical speculations.

In private life Ampère was a man of great simplicity of character and was subject to occasional fits of absent-mindedness, which often made him the subject of much innocent amusement. He was whole-souled and honest, taking no part in petty jealousies, which too frequently disturb the peace of the scientific world even to the present day.

He died universally respected and loved for his great integrity, kindness and scientific abilities. His death, due to a chronic affection of the lungs, came on June 10, 1836. So passed from this world a man who deserves the full admiration of every electrician and experimenter of to-day for his early and excellent basic work in electricity. He paved the way for the rapid progress and development of electro-dynamic machinery.

ELECTRIC FACTORY ON SEA.

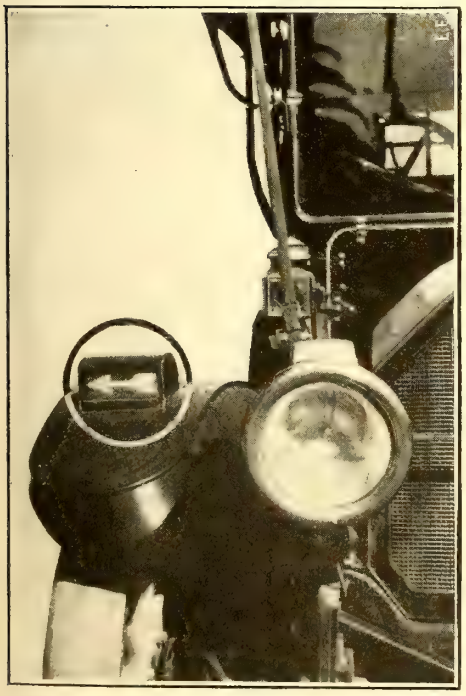
The American ship "Mills" is a floating electrical oil and fertilizer factory. The "Mills" is equipped from stem to stern with electrical machinery. Arc lights and searchlights enable the sailors to catch menhaden fish, similar in appearance to the herring, but not edible. Nets are slung over the side and hauled in by electrical hoists. Electrically driven screw conveyors carry the fish into receiving tanks and automatically feed the steam cookers where the fish are pulped.

The pulp is forced through a rotary press to extract the oil, which is then electrically conveyed into testing tanks, where it is cooled and then carried into storage tanks of 20,000 barrels capacity.

THE LATEST AUTO SIGNAL.

The latest thing in the way of an automobile signal or direction indicator is that recently invented by Ed. E. Peck, of Los Angeles, Cal. This set of signals consists of four small boxes, one of which is placed on the fenders of each of the four wheels of the machine, and which may thus be readily seen from any position.

The operation of this system of signals is extremely simple. When a machine is equipped with this apparatus it is impossible to misunderstand the intention of the driver as to the direction in which he desires turning. If he drives along the street and approaches a corner where he desires to turn to the right he simply turns the little electric switch on the steering wheel to the right. This movement causes the signal over the right front wheel to produce an arrow, as shown in the illustration, indicating that the driver intends turning to the right. At the same time, the two acting simultaneously, the little instrument on the fender over the rear wheel produces the word "Right," so that anyone coming up behind may not be puzzled as to which way the driver of the machine ahead of him is going to take at the next corner. When desiring to turn to the left, the driver simply turns the switch to the "left" position.

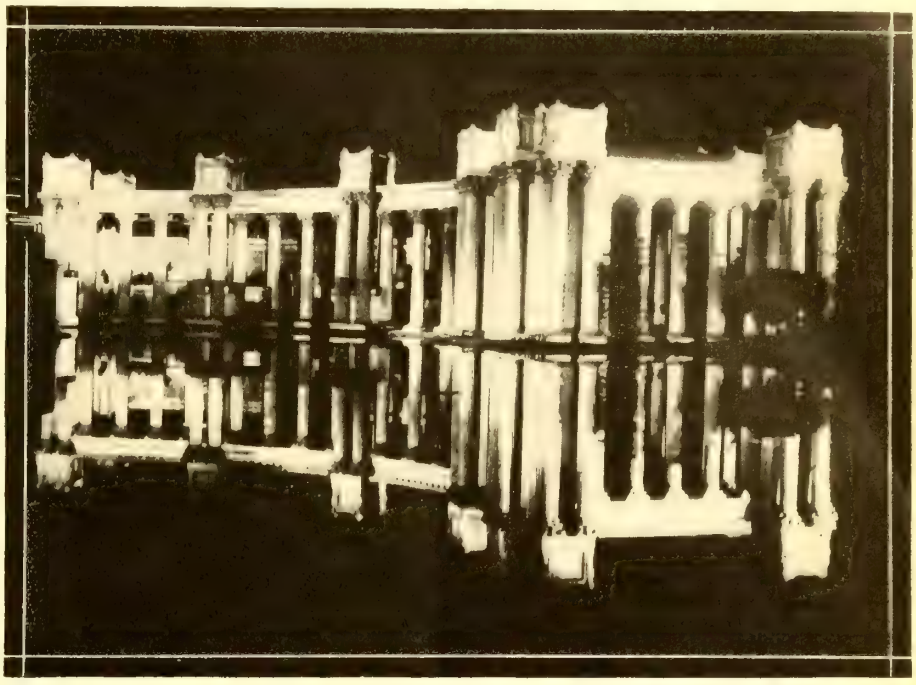


Effective Electric Auto Signal (in Circle) Tells Which Way Driver Intends to Turn.

This signal is so situated that it may readily be seen by the pedestrian and auto driver alike. It is proving quite popular, and promises to be universally adopted before long. The apparatus is waterproof and may be run winter and summer with equally good results.—*Photo by Albert Marple.*

BEAUTIFULLY ILLUMINATED BUILDING AT 'FRISCO EXPOSITION REFLECTS OWN IMAGE.

One of the most brilliantly illuminated buildings at the 'Frisco Exposition is shown in our illustration. This is the Palace of Fine Arts and as observed the reflection in the lagoon at night is so remarkably clear that the picture looks as well upside down as it does right side up. This building is one of those intended to be saved as a memorial of the great exposition, when it shall have closed its doors and will then be no more, except in memory. This picture was taken by the Cardinell-Vincent Co., official photographers of the Pan-American International Exposition.



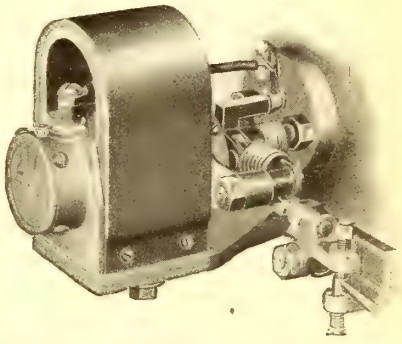
Almost Perfect Reflection of Wonderfully Illuminated 'Frisco Exposition Building.

Thousands of deftly hidden electric bulbs create the striking effect here observed, and this was one of the underlying keynotes in the general arrangement of the whole exposition lighting scheme. The age of glaring electric bulbs or, indeed, any highly brilliant source of light, has passed and illuminating engineers of to-day are as one, in the firm opinion that the best light is a diffused one, providing the proper illumination can be obtained without unduly sacrificing the desired brilliancy and illumination efficiency. The glare from unshielded or direct lighting proves a very sever strain on the eyes and one of the greatest American diseases now prevalent, and one that has threatened the health of thousands of people, is thus innocently caused.

Millions of electric bulbs of various sizes, types and shapes served to make the exposition one of the greatest in the annals of history, and it may be truthfully said that it appeared as one great blaze of light against the overhanging mantle of night; a sight once seen, never to be forgotten!

OSCILLATING MAGNETO STARTS GASOLINE ENGINE FROM REST.

The majority of magnetos in use to-day on gas engines are not capable of firing the charge in the cylinder of such engines until they have been speeded up considerably. A novel and important improvement in this line has been brought out by a progressive manufacturer in the form of the Wizard oscillator. This permanent magnet type dynamo is fitted to oil or gasoline engines in such a way that at every stroke of the piston in the engine the electro-magnetic armature of the magneto is rocked through part of a revolution in a rapid manner. As we know, it is possible to produce an electric current with a machine so constructed and in which the armature does not rotate at all. If the armature is turned through, say 90 degrees, against a spring pressure suitably applied to the shaft, and then if a trip or cam allows the electro-magnetic member to fly backward a powerful current will be induced in same. Upon this unique principle, which is thoroughly reliable, of course, there has been developed this new form of machine which, most important of all, permits of starting the engine from an absolute standstill. When the engine is turned over slowly, even through one revolution, a magneto of this type will produce just as hot a spark as will ever be produced when the engine is up to full speed. Thus the use of batteries is done away with. The illustration shows one of these oscillating magnetos mounted on a 2½-HP. floating governor kerosene engine. A standard igniting trip with advance and retard mechanism was used.



Unique Oscillating Magneto for Engine Ignition That Rocks Back and Forth Instead of Rotating.

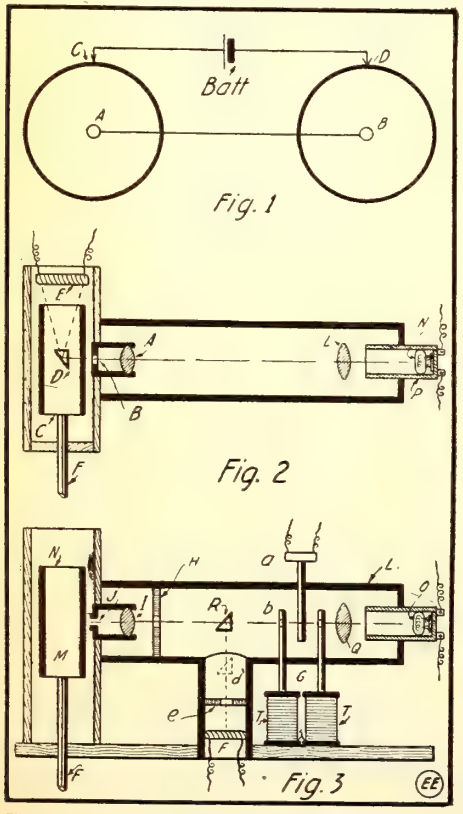
The Transmission of Photographs Telegraphically

By Samuel Cohen

THE transmission of pictures telegraphically has occupied the minds of many engineers and scientists for the past 60 years, until at present several systems have been perfected, to a degree, and placed upon the market as a commercial product. These machines are at present used by several journals, as the requirements for sending photographs from one place to another requires this service to be very fast.

It seems difficult, at first thought, to conceive how a picture can actually be telegraphed. But a picture, just as a written message, can be split up into more or less minute component parts, thereby making a complete photograph when these parts are combined again.

The transmission of photographs over a wire was promulgated back in 1847, when Bakewells began his research work in this line, and it is upon his system that the three most successful modern methods of picture transmission are based. His apparatus consisted of two synchronously revolving cylinders. Upon one was placed a sheet of tinfoil with the sketch drawn in ink; on the receiving drum there was placed a sheet of paper, prepared chemically, so that on passing an electric current through it a stain was made, due to decomposition of the chemical by the electric current. Fig. 1 shows the general schematic diagram of the apparatus, and it works as follows: When a line in the sketch comes under the stylus C, at cylinder A, the current flowing through the circuit will be broken wherever the cylinder is coated with (shellac) ink; but at such points of the picture where the bare tinfoil lies between the stylus C and the cylinder A the current will readily flow. It therefore flows intermittently through the chemically prepared paper attached to the



Figs. 1, 2 and 3. Telegraphic Picture Transmission Apparatus.

drum B, through the stylus D, and when it flows it makes a (electro-chemical) mark on the paper. Hence, when the stylus has traced over the entire length of the sketch at A, the latter will be finally reproduced at B. Such a system was very readily carried out in the laboratory, but it failed in the commercial field.

Further attempts were made to solve the problem, but it was not until Amstutz and Shelford Bidwell came along and discovered the value of using *selenium*, that mysterious element capable of changing its electrical resistance when exposed to light. The former scheme made use of variations in the strength of electrical current.

The work of these prominent men in this particular field led Professor Korn to develop a new system, and he is to-day the inventor of the most highly perfected machine for transmitting photographs over a wire. His system will be herewith described and is schematically shown in Figs. 2 and 3. The transmitting apparatus consists of a Nernst lamp, N, inserted in a sliding tube, P, provided with the lens L, and in this way a strong beam of light is projected to that part of the apparatus at the left. Here there is placed the lens A, which is mounted in a sliding tube having a small diaphragm at B. This latter comes close up to the glass drum C. Around this drum is wrapped a *positive* photographic film representing the photograph which is to be transmitted. The light passing through certain points of the film is received by a total reflection prism, D, and is sent from thence to the top, where it falls on the surface of the selenium cell E.

As the cylinder is mounted on the rotating shaft F, which operates in the same way as a phonograph cylinder, it revolves and at the same time rises, so that all the points of the image are brought in succession past the beam of light at B. Thus, an opaque point in the film will cut off all the light, and there will be none received on the selenium cell, while a transparent part gives the full light on the cell. The selenium thus receives differing amounts of light, corresponding to each point in the image. As it is connected together with a battery in the line, the distant receiver will receive a current which is variable; these variations following each other in very rapid succession. The receiver then acts according to these changes.

The receiving apparatus employed is outlined in Fig. 3, and it consists of a Nernst lamp, O, and the lens Q, which sends a beam of light toward the left. This beam passes through the apparatus G, which acts upon a galvanometer shutter. G receives the incoming current and serves to cut off more or less of the beam, according to the strength of the current at any instant. The current is received in the upper part (a), which carries the shutter and, moreover, is mounted between the poles of a powerful electromagnet TT. This apparatus is built similarly to the Einthoven galvanometer. The light beam from the Nernst lamp passes through the diaphragm of the galvanometer toward the prism R, on through the screen H, carrying a diaphragm and then passing through the lens I, and small hole J, falling finally upon a photographic film M. This is wrapped about the

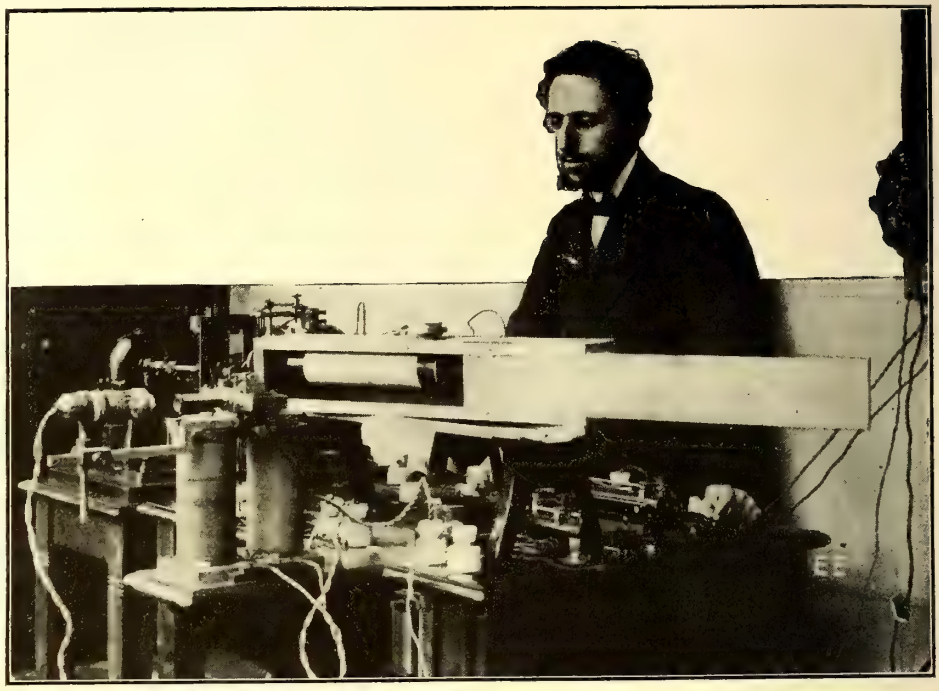
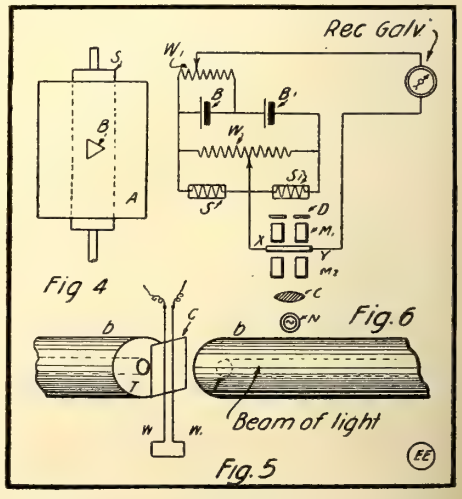


Fig. 7. Prof. Korn and His Apparatus Used in Sending Pictures Over a Wire.



Figs. 4, 5 and 6. Details of Receiving Apparatus.

metal cylinder N, which is rotated at the same speed as that used in the transmitter by means of a synchronous motor. The point of light at J thus acts on the film as it revolves, and as the value of the light corresponds to the white or dark parts of the transmitted picture all the points of the latter are reproduced in succession on the sensitive film; so, finally, we have the whole of the image reproduced. It only remains to remove the film and develop same.

To have the beam of light at the receiver

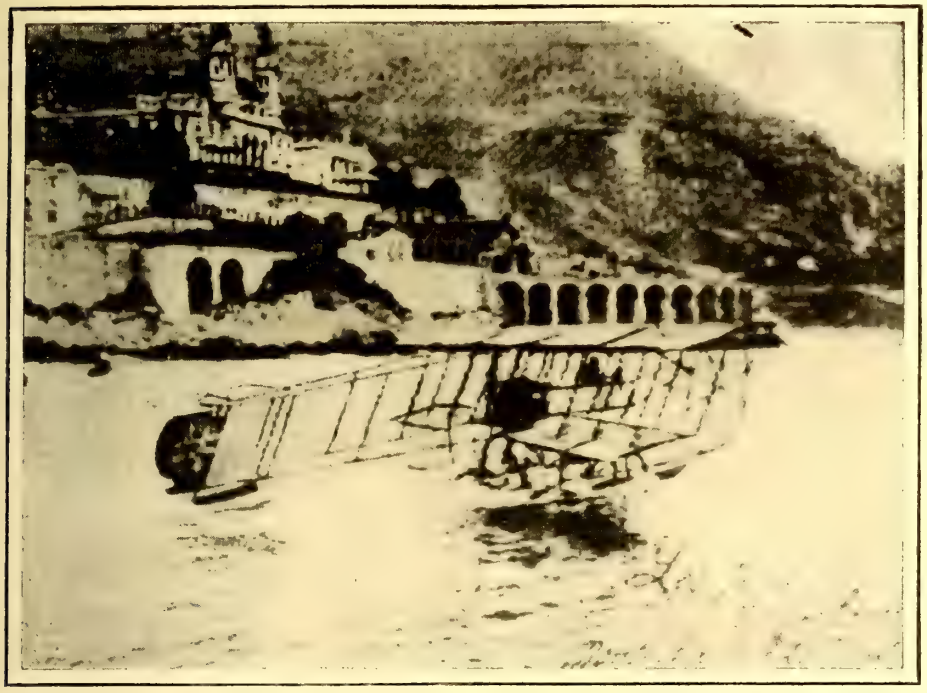


Fig. 9. Actual Reproduced Photograph as Transmitted Over a 400 Mile Telegraph Circuit to a French Newspaper.

correspond exactly to the current values on the line, the swing of the shutter should be proportional to the current, so as to give the proper amount of cut off to the beam of light. But the galvanometer cannot be constructed to have a swing, which is proportional to the current value, and an apparatus to correct this is required. This is depicted in Fig. 4. At A is a screen with a triangular shaped hole, B, which is covered by the shadow of the aluminum shutter C (Fig.

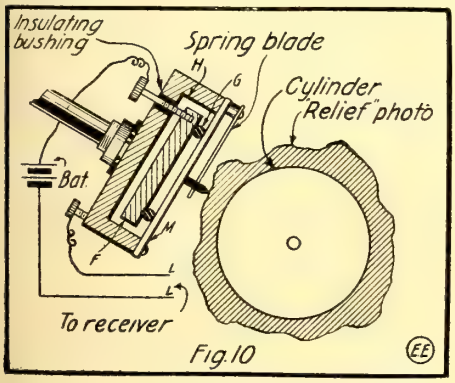


Fig. 10. Microphonic Translating Device for Use With "Relief Negatives."

5); when there is no current passing through wires WW_1. When the shadow moves off the hole the amount of light which is admitted to the lens is varied in a different way from the ordinary, owing to the particular shape of the diaphragm, so that we now have an amount of light which is about proportional to the current in the line. This was one of the hardest problems encountered in the transmission of photographs by this scheme.

While a selenium cell fails to respond quickly enough to the light, due to the inherent inertia of the cell, this was overcome by using another cell in connection with the regular one, and it was also discovered by Dr. Korn. This he called the compensator, and it is schematically depicted in Fig. 6.*

Here the light which has traversed the revolving photographic film falls on the selenium cell S_1. This cell is placed in one arm of a Wheatstone bridge; a second cell, S, being placed in the opposite arm. W is a regulating resistance, and B and B^1 are two batteries of about 100 volts, B being provided with a compensating variable resistance, W_1. The galvanometer is of the "string" form, i. e., two fine wires, X and Y, move laterally in the field of a powerful electromagnet, whose pole pieces, M_1 M_2, are tunneled with a small hole. A small piece of aluminum foil is stuck on to the wire in the center, and it is this shutter which just cuts off the light that would pass from the lamp N through the poles. If current passes through the wires X Y, they are laterally displaced, and the beam of light can then reach the second cell S_1. Now let us see what happens when a bright part in the photograph causes light to be cast on the cell S_1. The equilibrium of the bridge is at once upset, and the current, therefore, passes through X Y; the shutter is displaced and light falls a fraction of a second later on selenium cell S, thereby keeping the current in the receiver constant.

In the receiver we use the total reflection prism R (Fig. 3), which is moved into the path of the light beam, and it sends the beam down the vertical column to the diffusing screen e, and the compensating cell F, as portrayed in Fig. 3. This cell is connected to the main cell, as described above, and the combined current is sent on the line.

Fig. 7 and Fig. 8 illustrate the complete Korn apparatus, while Fig. 9 represents an exact photograph as transmitted over a wire by the above-mentioned apparatus.

One of the most indefatigable workers in the field of photo-telegraphy is M. Edouard Belin, who has been for some years actively engaged in working out a system of his own. His apparatus has been designated the telestereograph, but as his method of transmission has quite recently undergone a radical change it will be better to describe his first successful models by themselves.

The use of a relief photograph in which different tones in the image are represented by different thicknesses of the film, to vary the amount of resistance in an electric circuit containing a suitable receiver, has been referred to in the beginning of the article and the idea is a very old one. But the methods employed by M. Belin, both in the mechanism for varying the resistance and in the means of reception, prove very ingenious, and he obtained some promising results in tests over artificial lines.

The schematic diagram of his sending apparatus is illustrated in Fig. 10. A photograph in relief is obtained by reprinting from an ordinary negative upon what is termed carbon tissue, this being paper coated with gelatine and which is rendered sensitive to light by the addition of sodium bichromate. When sufficiently exposed, the paper is developed in hot water, when the gelatine washes away from the unexposed parts, but remains insoluble where there has been much light exposure; moreover, in the "half-tones" the gelatine washes away only to a certain extent, depending on the amount of exposure, i. e., on the density of the negative. Now let this relief film be wrapped about a cylinder, which quite resembles a phonograph cylinder, as seen in Fig. 10. The transmitter has a special kind of microphone using the metal box H, which contains the metal disc F at the back. Upon this is placed a thin carbon disc having three holes one-tenth of an inch in diameter, and a carbon grain, G, is placed in each hole, so as to make microphonic contact with the outer carbon plate M. The three grains are mounted so as to form an equilateral triangle and thus give an equal pressure distribution. Upon the grains is placed an outer vibrating diaphragm, M, of carbon, as observed. To transmit the movement from the photographic film to the microphone there is used a double point, mounted on a spring blade. One of them bears constantly on the film, and the other against the microphone, so that the latter receives the difference in pressure due to

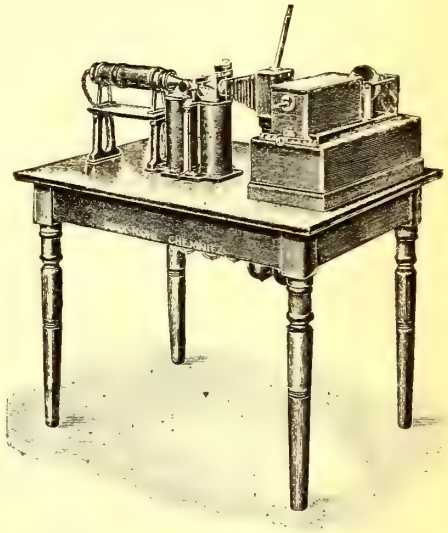


Fig. 8. Complete Telephotographic Apparatus of Dr. Korn.

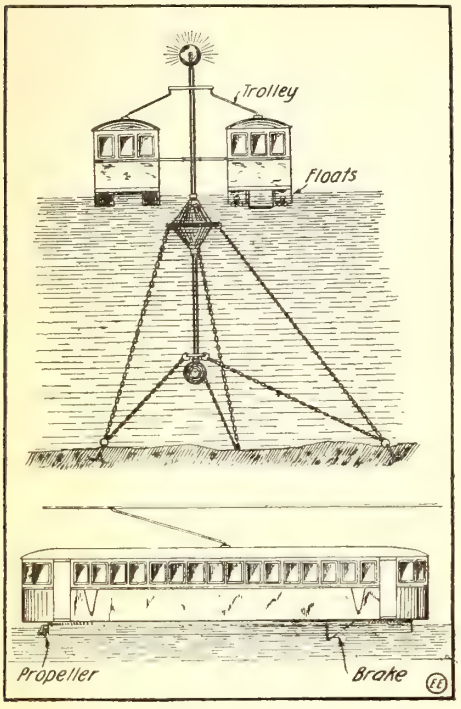
the varying relief on the film. Connection is made between the metal part of the disc F, on one hand, and the carbon plate, on the other, so as to give microphonic action and resulting variations of resistance in the line L L.

(Continued on next page.)

*From "The Telegraphic Transmission of Photographs," by T. Thorne Baker.

A FLOATING TROLLEYWAY AND PASSENGER CAR.

Here is a real seagoing car and a fresh thrill for the visitors to summer resorts



Recently Patented Floating Railway.

and pleasure parks. The new device is intended mainly for recreation purposes, but it could be easily placed in service as a river ferry for the conveyance of passengers.

The floating trolleyway which transmits the power of locomotion consists of a number of poles, arranged as the purpose for which the device is to be used may prescribe, anchored to the sea, lake or river bed. A car body with an electric motor and passenger-carrying equipment is mounted upon suitable floats, which are pointed at the forward end so that they will offer very little resistance to the water.

A special trolley, which always retains its connection with the overhead wire and arms at the side, which engage a stout wire strung midway between the poles of the trolleyway, help keep the car on the right path, though separate steering means are also provided. The electric power is furnished from any convenient source to the electric motor of the car, which in turn drives the propellers at the rear ends of the floats and sets the car in motion.

At night the car as well as the entire trackway is illuminated, electric lights placed upon the tops of the floating poles being the medium through which the floating trolleyway is lighted. To facilitate the stopping of the floating car when a station is reached, a brake placed between the floats which when dropped enters deep water, offers a strong resistance to the continued motion of the car and brings it to a halt in short order. When the car is in motion this brake is swung upward and out of the water.

This scheme will be practical for ferry purposes only on small inland lakes or rivers, where there are no large vessels and the water always calm.

ELECTRIC SEWING MACHINE MOTOR STAYS WHERE YOU PUT IT.

One of the latest household electrical devices is an improved form of sewing machine motor readily attachable to any style of machine and it also requires no screws or clamps to hold it in place. It is known as the "Dumore" motor and is equipped with three special spring feet, as perceived in the illustration. These feet are fitted with rubber cushions to prevent marring the surface of the woodwork, and the cen-



The "Dumore" Sewing Machine Motor Remains Where You Set it Without Clamping.

(Continued on page 517.)

THE TRANSMISSION OF PHOTOGRAPHS TELEGRAPHICALLY.

(Continued from page 483.)

At the receiving end is a similar rotating cylinder, carrying a sheet of photographic paper or a film (Fig. 11), and the currents are received in a galvanometer device which throws a variable spot of light upon the paper. A Blondel oscillograph fitted with a swinging mirror in a strong magnetic field is used in this system. A strong current thus gives more swing and a weak current a lesser swing. The beam of light passes first through a short color screen, C, graduated from dark to light, so that when the beam is at zero it occupies the dark end of the screen. A swing of the beam brings it to the more or less transparent part, and the resulting beam will thus depend in value upon the strength of the current. Fig. 11 shows a diagram of the arrangement of each part of the apparatus. A is the string

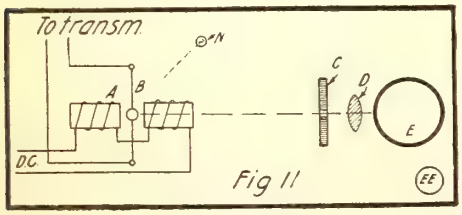


Fig. 11. Details of Receiving Galvanometer.

galvanometer with a mirror, B, attached to a fine wire which is connected to the transmitter, as perceived. A ray of light from a Nernst lamp, N, is focused upon the mirror, which reflects it toward the receiving cylinder E, in the meantime passing through the screen C, and condensing lens D. The revolving cylinder E is kept at the same speed as the transmitting cylinder, this being done by means of a synchronous electric motor on each end.

The latest achievement in the transmission of photographs is that employing wireless telegraphy. The great advantage of wireless over wire telegraphy is quite well known to-day for its long distance and the communication with ships at sea, and the same application can be applied to photo-telegraphy when a proper system is developed. For instance, pictures of criminals could be readily telegraphed to ships fitted with proper receiving apparatus, and sketches or plans could be transmitted between different corps of an army or between ships.

Various systems were developed, but the most practical one is that which T. Baker, of England, has perfected, and this is schematically illustrated in Fig. 12. The upper one shows the transmitter, while the lower one is the receiver.

At D is a drum, the same as used in the wire photo-telegraphic apparatus, a stylus tracing over a sketch drawn with insulating ink on a sheet of leadfoil; D and the stylus are shunted with a condenser, C, to prevent sparking. The current from the battery A is interrupted by the lines of the picture, the magnetism in M being thus intermittent. The relay at M breaks the contact of the battery B in circuit with the primary P of an induction coil; S being the secondary, and thus electrical oscillations are set up in the aerial AN and ground GR. A negative print is placed on the drum D, so that sparking between the balls B_1 takes place only when a line in the picture comes in contact with the stylus. The capacity K and inductance J in the oscillatory circuit can be adjusted as required, and for long distances the aerial and earth would be connected inductively.

Turning now to the receiving apparatus, the aerial and ground are connected to the primary of a loose coupler, LC, the current being transformed into the secondary, S, and passed through a sensitive coherer, C, with a condenser, K, in series. A rather insensitive relay is inserted in the coherer and battery circuit, the battery consisting of the two dry cells. The local circuit of this relay actuated a second relay through another battery, and the local circuit of this second relay included the receiving circuit of the photo-telegraphic apparatus, as becomes apparent.

The use of a shunt circuit running through the receiver was necessary to render the marks clear and short.

A local shunt circuit was also used from the first relay to actuate the de-coherer, which consisted of a very lightly built electromagnetic striker which tapped the coherer.

Quite wonderful results were obtained

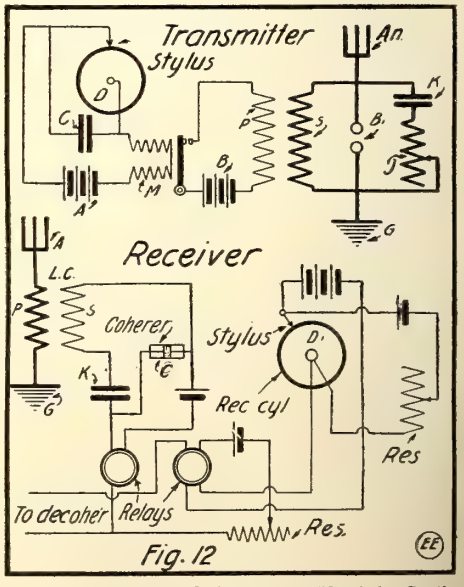


Fig. 12. Circuits of Apparatus Used in Radio Transmission of Pictures.

with this apparatus, and photographs were readily transmitted for short distances, although the received pictures were not very clear.

The time is near at hand when we will be able to send our pictures to our friends in distant cities and ships at sea as easily and cheaply as in sending word messages.

RADIO DEPARTMENT

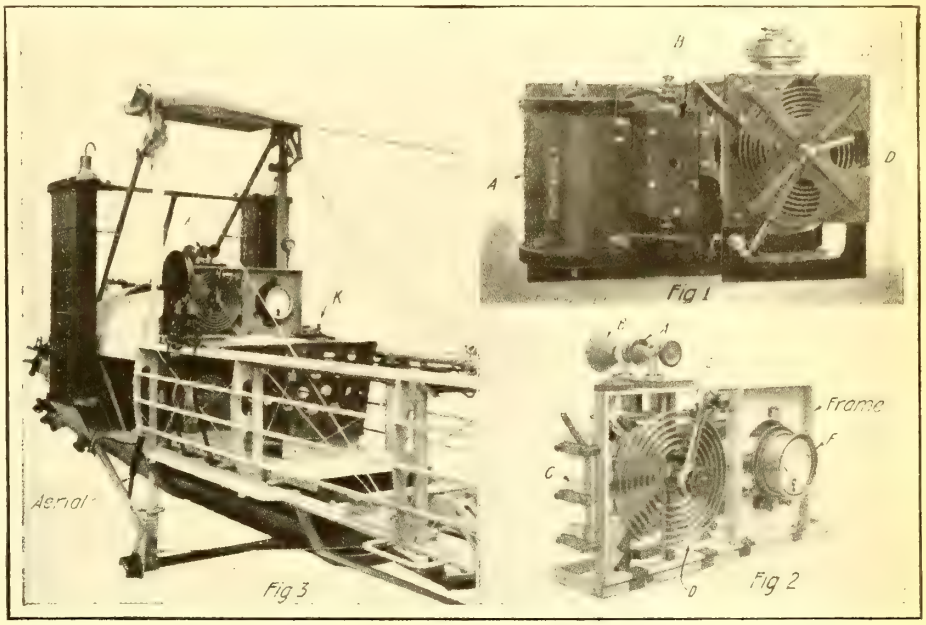
Wireless on the Firing Line

ONE of the most important elements in the present European conflict is wireless telegraphy, which is very extensively employed for directing squads of soldiers, communicating between trenches and exposing the enemies' position by means of aerial reconoitering.

Various types of instruments are being used and we herewith present some views of the transmitting sets which are in use for this purpose. Fig. 1 illustrates a typical synchronized outfit, comprising an open core, oil-cooled, transformer A, connected to an alternating current supply, through a key, as usual. Its secondary is linked to a specially designed condenser B; this is carefully built, as it is sometimes necessary to overload it. The spark gap C is of the rotary synchronized type, and is mounted on the end of the generator shaft. The helix D is of the standard type, consisting of a spiral of brass strip held in fiber supports, as perceived. This outfit has a capacity of 150 watts, with a radiation of one ampere in the aerial. The ground connection is simply made to the base of the engine. The set has a spark frequency of 800 per second; complete, it weighs about 30 pounds. The apparatus is designed and constructed particularly for operation on an aeroplane, where the air draft created by the motion of the machine is utilized for cooling the various parts, especially the spark gap.

Another unique wireless plant designed especially for use in aeroplanes is depicted in Fig. 2. This is somewhat different from the one previously described, as it employs a stationary gap A, instead of a rotary one. The gap cooling funnel B is used for concentrating the forced air produced by the motion of the aeroplane. The high tension condenser tubes C are placed behind the frame, as perceived. These are of a similar type to those used in the previously described set. The helix D is of standard type; note the method of changing the wave length on same by means of a switch. It employs a novel scheme, on the rotating arm E, which does not scrape the metallic band when the arm is revolved. A hot wire ammeter F is employed for indicating the current in the antenna circuit.

A very interesting illustration is shown in Fig. 3. This is an actual photograph of an aeroplane of the biplane type, fitted out with a wireless transmitting outfit of the same design as that just described. The stationary air cooled spark gap is shown at A, while the key K is located on the operating table. The aerial is sometimes made to comprise the guys of the flying machine, providing they are insulated from the engine proper, as the latter is employed for the ground. If these guys are grounded, then a long wire is lowered from the aeroplane, which is wound up and let out from an automatic winding drum, easily controlled by the aerial radio operator.



French Aeroplane Radio Equipment. Note Aerial Weight at Left, Which, Attached to a Flexible Wire, Enables Antenna to Be Unreeled to Any Length Quickly.

TWO NEW WIRELESS DETECTORS.

An enterprising wireless concern of New York City has recently developed an improved mineral wireless detector which undoubtedly will find great favor with both amateur and commercial radio operators. This detector is of very sturdy construction and rests on a marble base (see Fig. 1). Two hard rubber uprights support a glass cylinder, which incloses the working parts of the detector proper and thus prevents dust settling on them, besides keeping out dampness, etc. The hard rubber knob A, at the left, has a rotary movement and carries the "cat-whisker" wire, which rests against the mineral mounted in a cup and carried on the stem connected to the knobs B and C, at the right. The knob B permits of rotating the shaft on which the mineral cup is fastened in an eccentric manner, so that any portion of the mineral becomes accessible to the contact wire or "cat-whisker." By means of the smaller knob C, and by turning it, the cup may be approached to or receded from the "cat-whisker" wire; a strong spring placed under the mineral cup tends to push it forward normally. A distinct novelty in this detector is the tube D, which connects with an inner passageway opening into the glass chamber. This tube is for the purpose of introducing any gases or compressed air, etc., into the detector chamber, so their effect on the operating characteristics may be noted and experimented with. Ordinarily, if no gas is to be used in the detector, the tube may be closed with a cap. It has been found that, for instance, illuminating gas increases the sensitiveness to a remarkable degree. A novel way in treating the galena renders this detector practically immune from all light shocks.

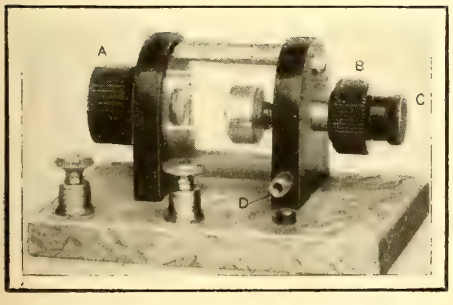


Fig. 1. Improved Dust-Proof Detector Fitted With Gas Inlet for Experimental Work.

Another detector of the mineral type and of commercial pattern is shown in Fig. 2. This detector resembles a cartridge fuse and may be snapped in and out of place in

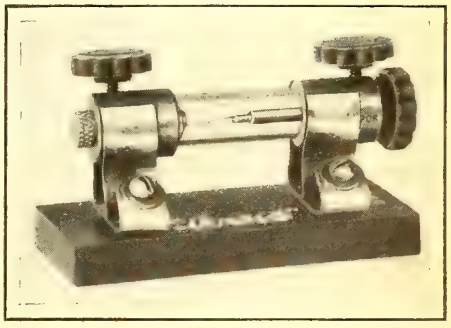
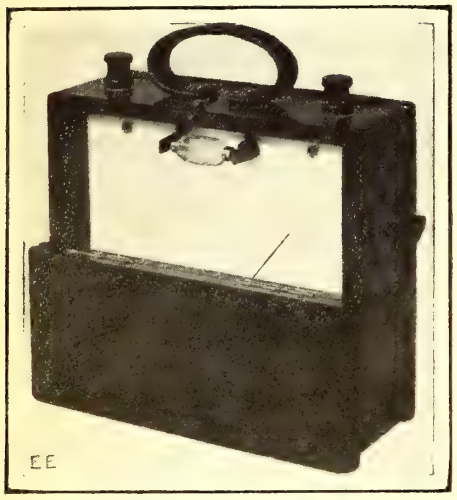


Fig. 2. The Lenzite Detector Utilizes a Synthetic Mineral and Is Also Dust-Proof.

(Continued on page 516.)

A DIRECT READING WAVE METER FOR RADIO MEASUREMENTS.

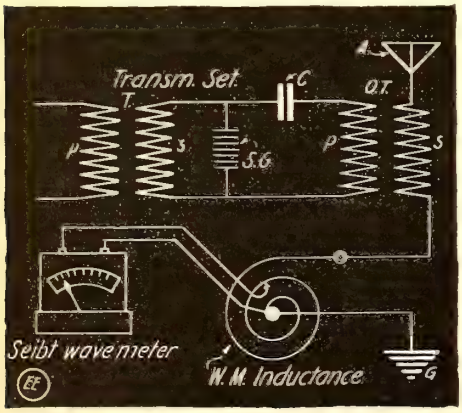
In the accompanying illustration is depicted the first commercial type produced of a direct reading wave meter as developed and perfected by Dr. Georg Seibt, of Berlin-Schoenberg, Germany. This instrument is connected in the ground wire of the wireless transmitting system and as near to the earth connection proper as possible. It is inserted in the circuit by shunting the meter itself across an adjustable inductance composed of a few turns of copper ribbon, which inductance is hooked up in series with the ground wire, as diagram shows.



A Direct Reading Wave Meter That Resembles Ordinary Voltmeter.

This particular instrument has two calibrated scales, the first scale reading from 300 to 1,500 meters wave length, the second scale from 1,500 to 3,000 meters wave length. It is quite delicate in construction, but, however, is more rugged than would seem at first possible. This was demonstrated in a test of same which was conducted on an aeroplane wireless set, where very severe vibrations were encountered.

This meter is very peculiar in action as compared with most other direct reading electrical instruments, in that its needle does not have any definite zero point, and it may come to rest at any point along the scale, depending upon the wave measured when last used. When the meter is connected in circuit the needle of same very quickly takes up the proper position, indicating directly the wave length in meters of the circuit to which it is attached. One feature about this instrument is that the scale divisions are equal and thus easily read.



How the New Wave Meter Is Connected to a Radio Transmitting System.

It has been tested by Dr. Austin, of the United States Bureau of Standards, and found to have an accuracy of approximately 1 per cent. Readings are preferably taken with this instrument when it is placed in a horizontal position.

No iron enters into the construction of the wave meter, and motion is produced in its mechanism by means of two hemispherical coils, oppositely disposed on either side of a very light aluminum member, which is mounted very delicately on a pivot and an indicating needle is attached to this movable member.

A switch mounted on the side of the wave meter permits of changing the internal connections, so that either scale may be used. Directly above the scales may be observed an indicating glow lamp, which is used for the following purposes: Theoretically the indications of the wave meter are independent of the current flowing, but in actual practise it is necessary to keep the current between certain maximum and minimum limits for best results. When very small currents are passed through the instrument there can be no certainty that the friction of the pivots exerts no effect on the reading, or that a slight unbalancing of the armature will not render negligible the effect and also that the slow motion of the pointer or needle under the action of small currents makes the reading uncertain. To readily ascertain that the current flowing through the meter has the correct value the small indicating (tungsten) lamp above the scale is noted. This lamp is so chosen that the slightest dark red glow indicates the minimum allowable current, while a bright white light in the bulb denotes the maximum permissible current which should be passed through the wave meter. It does not matter whether any particular degree of brightness is obtained, but in order to have the small glow lamp last the longest possible time it is desirable to work nearer the lower current limit. For those interested in the details of the actual construction and peculiar operating features of this very ingenious device it would be well to refer to Vol. 1, Part 3, of the Proceedings of the Institute of Radio Engineers.

MARCONI RADIO SCHOOL IS OPENED.

Telling of the wonders accomplished by wireless telegraphy of late, Instructors Warren C. Graham and T. George Deiler recently opened the new school for the training of commercial radio operators, recently recommended to be placed in New Orleans, in the Young Men's Christian Association building in St. Charles street, by the Marconi Wireless Telegraph Co. of America.

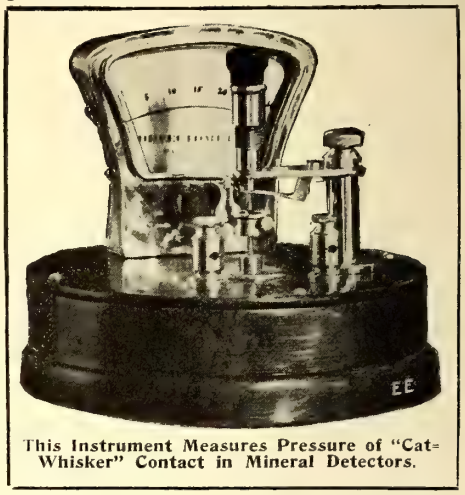
The opening of the new institution was well attended and a large number of pupils were enrolled. The successful operation of the school is now assured, and it will be permanently established in New Orleans.

The novel institution, which is the only one of its kind in the South, has been thoroughly fitted out with Marconi apparatus valued at $4,800, similar in type to the sets used on ocean liners, and will not only instruct students in the operation but also in the maintenance of commercial wireless apparatus.

A DEVICE THAT MEASURES PRESSURE ON DETECTOR CRYSTALS.

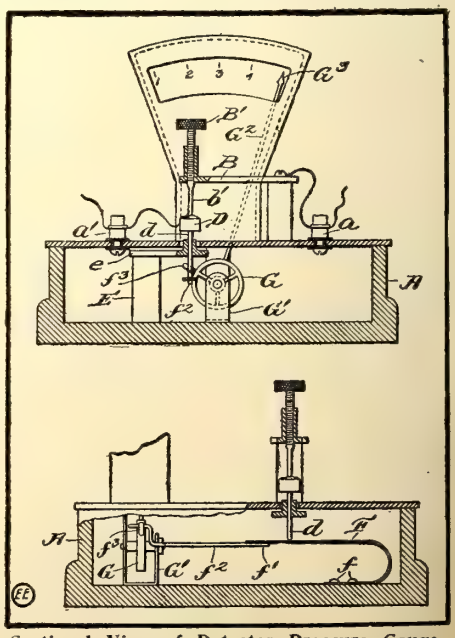
A novel and apparently quite useful wireless device, known as a Detectometer, has been perfected and patented by Arthur G. Carlson, of North Easton, Mass. Mr. Carlson is a rather youthful inventor and he has apparently developed in this instrument a more or less useful device for the measurement of the pressure exerted on wireless detector minerals. The photograph and sectional drawing herewith will help to bring out the general appearance and working arrangement of this apparatus.

Referring to the sectional sketch, there is observed a standard form of mineral detector having a lower cup D, containing the mineral proper. On the mineral there presses downward an electrode b^1, carried by the metal bridge B. As increased pressure is exerted on the mineral by threading downward the electrode B^1, the lower end of the cup shaft, d, presses down on spring F. This spring is connected through f^2, with a small balance wheel G, supported in the bracket G^1. As will be evident, increased pressure downward at D thus causes the pivoted wheel G to rotate, and in consequence the attached needle, G^3, will indicate on the calibrated scale at the upper part of the instrument.



This Instrument Measures Pressure of "Cat-Whisker" Contact in Mineral Detectors.

The inventor of this device claims that it will be of superior value, as proven by actual tests, when, for instance, a radio operator may wish to readjust the detector with a certain mineral and under certain conditions. Presumably such is the case, and the patentee mentions also that it often happens that 15 to 20 minutes or more are wasted in trying to adjust otherwise the mineral in the detector to its maximum sensitivity; whereas, with this calibrated electrode pressure indicator, it is the work of but a minute or so to instantly readjust the detector to its most favorable condition.



Sectional View of Detector Pressure Gauge.

AN ULTRA-SENSITIVE WIRELESS RECEIVER.

The accompanying sectional drawing Fig. 1 illustrates the mechanism of a telephone receiver which is designed especially for increased sensitiveness. This receiver is



Fig. 2. Appearance of New Amplifying Wireless 'Phones.

of the watch case form and is adapted particularly to service in wireless telegraphy. Other forms of the receiver embodying the same general principle are useful in cases of partial deafness, for noisy places and in long-distance telephony.

The diaphragm 12 (see diagram) is not acted upon directly by a varying magnetic force as in other receivers, but it is made of mica and receives its impulses from a thin iron armature 9, to which it is connected by the link 14. This armature passes through an opening in a spool 8 (upon which is wound the single energizing coil of magnet wire) and is poised at the middle upon a pair of pivots, or preferably a fine wire loop, which is attached to the center of the spool. A spring 16 is arranged to press upon one end of the armature 9 in such a way as to produce a slight tension upon the link 14 and diaphragm 12, and at the same time hold the armature in proper position.

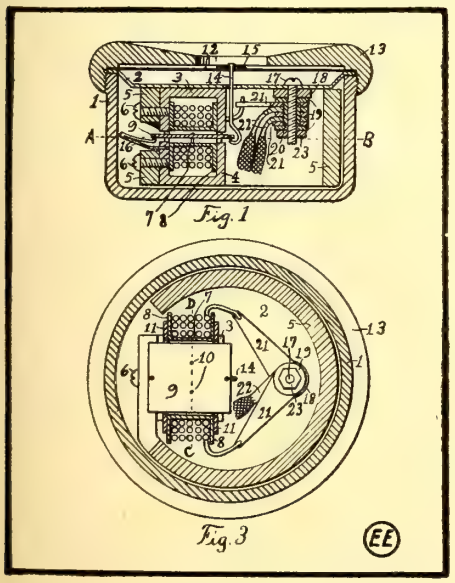


Fig. 1. Diagrammatic Sketch of Amplifying Receivers.

The spool is nearly surrounded by two U-shaped pole-pieces 3 and 4. A permanent steel magnet 5 surrounds these parts, and its poles, being made narrow, overlap and are secured to the pole-pieces by screws 6, 6. This holds the pole-pieces and spool together, and the cup-shaped member 2, which is secured to the pole-piece 2, forms a support for all these parts. This cup-shaped member, together with the diaphragm 12, is clamped between the shell 1 and ear-piece 13.

It will be seen that the flux from the permanent steel magnet 5 has a double path between the pole-pieces 3 and 4 across the armature 9. When there is no current in the spool of magnet wire the armature remains balanced. When a current traverses this coil the armature becomes polarized; and readily it can be seen that the magnetic action of all four ends of the pole-pieces will co-operate to produce a deflection of the armature 9 upon its fulcrum 7 in a direction depending upon the polarity of the energizing current. An alternating or varying current will produce oscillations of the armature, and this motion is transmitted to the diaphragm.

The following are features of advantage in the instrument. It has a long permanent magnet, being more than a complete circle, since the ends overlap. The magnetic circuit has comparatively little reluctance, having a double path between the pole-pieces. The air spaces are thin and the flux from the permanent magnet does not have to pass lengthwise through the armature.

These features of the magnetic circuit favor a strong flux and permanency of magnetization.

In the electro-magnet the thin armature is the main part which is affected by the energizing current; therefore the loss of power by hysteresis and eddy currents is reduced to a minimum. The winding is concentrated in a single spool and its effect upon the armature is utilized at both ends and on both sides at each end. In this way the force due to the polarization is increased to a maximum.

The diaphragm, being of thin mica, is very light and sensitive to the impulses from the armature. The diaphragm, armature, link and spring, together, weigh only a fraction of that occasioned by using a common iron diaphragm.

For wireless service these receivers are provided with a new form of head-band, which is very simple and somewhat automatic in adjustment. Fig. 2 shows the appearance of a head-set consisting of receivers, head-band and cord.

In this set two leather-covered, spring steel wires carry sleeves at their extremities. These sleeves hold heavy German Silver wires, which are split at one end and formed into arms which partly encircle the receivers. Pivots in the extremities of these arms engage with sockets in the receiver shells.

These wires can turn in the sleeves and the receivers can turn on the pivots. The wires can also slide in the sleeves to adjust the length; but when the set is upon the operator's head the binding effect of the wire in the sleeve prevents slipping. With these adjustments made, the set is simply placed upon the head in proper position, and it will stay there. There are no screws or fastenings to tighten.

NEW CABINET STYLE RADIO RECEPTOR.

The sponsors of the well-known Crystaloi detector have recently developed and commercialized a high-grade wireless receiving cabinet set which our illustration herewith shows. This set includes switch style tuning inductances and the outfit may be tuned to quite long wave lengths up to 3,800 meters. Special switching arrangements have been developed in this outfit which conduce to very rapid tuning, and the central dial switch has its contact points so arranged that with very little movement same is easily made to throw in either the short or long wave inductance sections which are, of course, inductively related and controllable by means of the two end dial switches.

The Crystaloi detector is seen mounted on the set, as well as the sliding plate, variable condenser, and this is perceived mounted at the center of the cabinet shelf. This condenser was described in the September, 1915, issue of the *Electrical Experimenter* and varies its inherent capacity by sliding more or less plates along two brass bars, half the length of which are specially insulated. By varying the distances between the plates by means of spacing washers it can thus, if necessary, be made up to cover a pretty fine range of adjustability, although, apparently, on first sight it would not give the fine range of adjustability procurable with the standard rotary variable style condenser.

This set tunes very sharply and also very quickly, all things considered, and the detector is indeed very rugged and permanent in its adjustment, a feature not to be



Newly-Developed Radio-Receiving Set Equipped With Crystaloi Detector.

found in ordinary radio receiving sets. This outfit comes complete and is furnished in a polished mahogany cabinet, while the shelf on which the switches and various parts of the apparatus are mounted is made of Bakelite. Even a dust brush is supplied with this set, as perceived, so that the apparatus may be kept scrupulously clean! This applies particularly to the space between the closely arranged switch points, where dust is likely to collect and the high frequency currents flowing through these parts may thereby be short-circuited, which will naturally lower the electrical efficiency of any apparatus of this type.

THE WIRELESS 'PHONE WILL GET YOU.

Many a man in the spring of the weather and of youth has stood on his doorstep and longed to be able to shout his thoughts to all the world. Many have felt this, but few have ever thought they could do it. Wireless telephony has made such a scheme within the range of the possibilities. If your wife is cross, or your enemy is hot on your trail, or the partner wants to tell you that note falls due to-morrow, don't think you can go to San Francisco or China and get away from her or them. Gadzooks! You can't—the wireless 'phone will get you.

Regenerating Audion Circuits for Wireless Receiving

By Frank J. Collins

THE arrangement of circuits and apparatus described in this article were invented by Edwin H. Armstrong, of Columbia University, and are to be used experimentally only.

While the coils described herein may be constructed by experimenters, they are not permitted to sell them to others for the purposes described, as the invention is patented.*

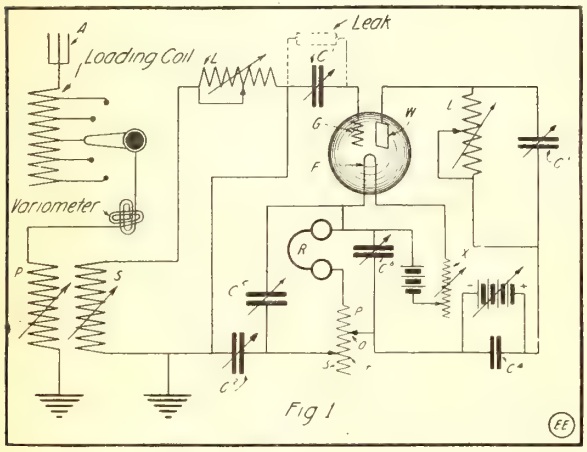


Diagram 1, for Regenerative Audion Detector Circuits.

The purpose of this discourse is to describe in plain and simple language the operation of this scheme, so that amateurs may construct and use same. While this arrangement may seem quite complicated in comparison with the ordinary audion circuits in common use, still, with a little practice all difficulties may be overcome.

These circuits are adapted to the reception of both damped and undamped waves, and are particularly suited to the latter.

When properly adjusted, this arrangement has an amplifying figure of from 10 to 500 times or more, depending on the amplitude (strength) of the incoming signal. In contrast to the ordinary audion amplifying circuits, only one audion is required, thus eliminating two or more audion bulbs, extra rheostats, batteries, etc.

As most of the high-power transatlantic and transpacific stations use wave lengths of from 5,000 to 10,000 meters, dimensions are given to cover these wave lengths only.

With an aerial 500 feet long, one wire elevated at least 40 feet above the ground, no difficulty will be experienced in reading stations 2,000 to 4,000 miles distant, day or night. Aerials 100 feet and up in length may be employed with good results, but for reliable communication a length of 500 feet or more should be used whenever possible on account of the long wave lengths employed.

The dimensions and description of the apparatus to cover the range of wave lengths mentioned are as follows:

Loose coupler primary tube 4 inches in diameter, 5 inches in length, wound full with No. 32 S. S. C. wire, bringing both ends of the winding to binding posts. No sliders or switches are necessary, as the full winding is always required.

The secondary tube is 3½ inches in diameter and 6 inches in length, wound with No. 32 S. S. C. wire; no taps are required in this case either, as the full winding is always in use.

As a great many of the high-powered stations use the "arc system" requiring very sharp tuning, a variometer is necessary. While a variable condenser may be shunted across the loose coupler or loading coil, or both, for sharp tuning, a variometer is preferable. A loading coil will also be required in order to tune to the long wave lengths.

The Grid and Wing Coils, L and L¹, Fig. 1, are identical in every respect. They consist of cardboard tubes, 30 inches long and 4½ inches in diameter, wound full with No. 32 S. S. C. wire. About fifteen equally spaced taps should be taken from each coil and brought out to switch points.

The switch on the Grid Coil should be connected to the last tap of same in order that the unused turns may be short-circuited or the entire coil cut out of circuit.

The switch on the Wing Coil should be connected likewise, viz., to last tap of the Wing Coil. Care should be taken in connecting these coils up to the other apparatus to see that the switch on the Grid Coil is connected to one side of the secondary of the loose coupler and that the switch on the wing coil is connected to the positive side of the high voltage (40-50 vts.) battery.

By short-circuiting the unused turns of the coils in this fashion, it prevents the operator's hands from interfering with the tuning to a large extent. These coils are very sensitive and should be placed at least two feet from each other, or at right angles, in order to reduce the mutual inductance between them.

The wing condenser, C 3, Fig. 1, is used for the purpose of tuning in longer waves than the inductance of the coil itself affords. It is also used for the purpose of "cutting in" between the taps of the wing coil, and has a maximum capacity of .0004 m. f.

The tuning condenser, C, is for the purpose of tuning the grid coil and the secondary of the loose-coupler to the incoming signal; it is very essential. It has a maximum capacity of .0004 m. f. In most cases a maximum strength of signals will be obtained with large values of inductance and small values of capacity, for a given wave length.

Since the internal resistance of the high voltage telephone battery constitutes a path of comparatively high impedance to the high frequency oscillations (incoming signals) it is advisable to use condenser C 4 (Fig. 1), connected directly across the battery as shown, in order to reduce this impedance. This condenser is not really necessary. It has a capacity of about 2.5 m. f. and may be adjustable in steps.

Care should be taken in constructing this condenser, for should it "break down" it would result in the complete loss of the high voltage battery by short-circuiting the same. Paraffin paper and tinfoil may be used in its construction.

Condenser C¹, Fig. 1, is very important and is placed between the grid coil and the grid of the audion, and it is used for the purpose of holding the charge which accumulates on the grid due to the incoming signals. Its capacity is very small, seldom exceeding .0002 m. f. This condenser is preferably shunted by a graphite resistance (leak).

This *leak* may be constructed by clamping a piece of cardboard 1½ inches long and ½ inch wide, between two binding posts, the whole arrangement to be connected across the condenser C¹. Then while "listening in" draw a few lines with a lead pencil from one binding post to the other on the cardboard. (These lines of graphite constitute a high resistance.)

This process should be kept up until the incoming signals reach a maximum of strength, as the effect of this resistance is to materially increase the strength and clearness of the signals. By decreasing this resistance (in ohms) static disturbances are decreased to a large extent, but at the expense of the incoming signal strength.

This resistance should be connected up after all the apparatus is hooked up and working, as the right amount can only be ascertained while signals are being received.

Condenser C 5, Fig. 1, is connected directly across the telephones and is very essential. It maintains the stability of the audion when receiving long waves and prevents the audion from generating high frequency oscillations. By keeping sufficient capacity across the telephones at all times this generating feature may be eliminated. The capacity of this condenser is .001 m. f. (maximum). The generating feature of the audion may be recognized by the signals losing distinctness, and a hissing or rumbling noise is noticeable in the telephones.

By grounding the grid circuit, as indicated in Fig. 1, the generating function may be eliminated to a certain extent.

The amount of voltage required in the telephone circuit will depend to a large extent on the degree of vacuum present in the audion bulb. Since all audion bulbs vary in their characteristics, the adjustment of apparatus obtained with a given audion bulb, when receiving signals from a certain station, will change when another bulb is substituted. The change of adjustment being principally in the grid condenser C¹ and inductance coil L¹, Fig. 1. It has been found best to have the ratio of transformation 2 to 1 in the transformer T, when its primary inductance value is equal to that of the telephones. (Or a telephone induction coil may be used.)

While the ordinary audion bulb is admirably suited for the reception of undamped waves, the double wing and grid audion bulb will give better results, as it is more stable and shows less tendency to "paralyze."

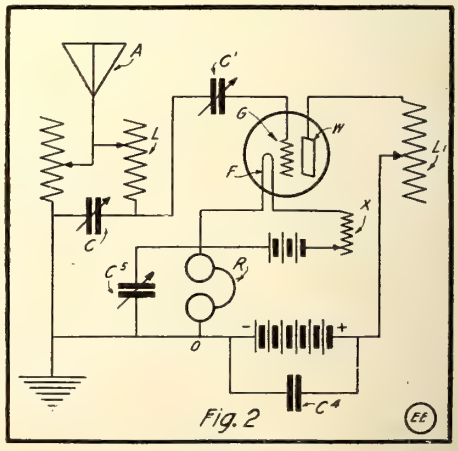


Diagram 2, for Simplified Armstrong Audion Circuits.

Another feature of this arrangement is the fact that the filament of the audion bulb may be adjusted to a comparatively low temperature, thereby prolonging the life of the bulb.

(*Continued on page* 517.)

* Patented Oct. 6, 1914, by Edwin H. Armstrong.

REGARDING SWITCH POINTS AND TIKKERS.

In making switch contact points a common practise is to use upholstery tacks as in Fig. 1, but frequently the shank is not long enough to pass through the mounting. In that case ordinary paper fasteners, Fig. 2, are used as sketched at Fig. 3.

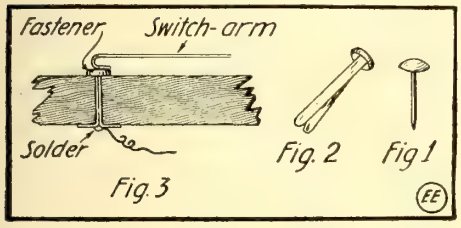
They may be obtained in many sizes and lengths, and are almost as cheap as the upholstery tacks.

They are excellent to use where it is necessary for the points to be set closely, in which case the manufactured switch contacts cannot be used because of the nut on the back.

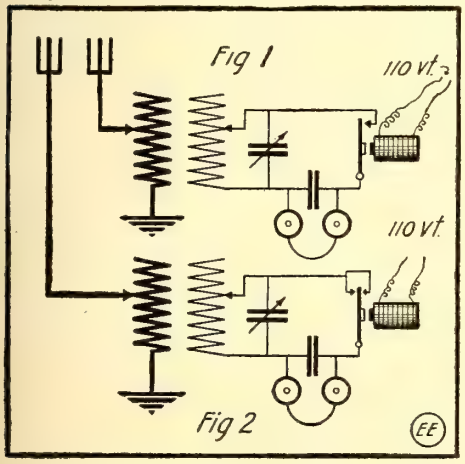
Many amateurs within range of the "Poulsen Arc" sets are making use of various forms of "tikkers."

Some of them use telegraph relays connected on 110 volts alternating current, as in Fig. 1. This does not give good results for the reason that the interruptions are too slow. Much better results are obtained by following the circuit shown in Fig. 2. This simply makes use of the "back stop" as a contact, and when connected as shown the arrangement gives twice the number of interruptions as before, consequently better results. It must be remembered that neither arrangement approaches the "wheel" or "tube" tikker in efficiency, and the relay should only be used when the other forms are impossible of attainment or impracticable. Contributed by

FREDERICK J. SCHLINK.



Using Paper Fasteners as Switch Points.



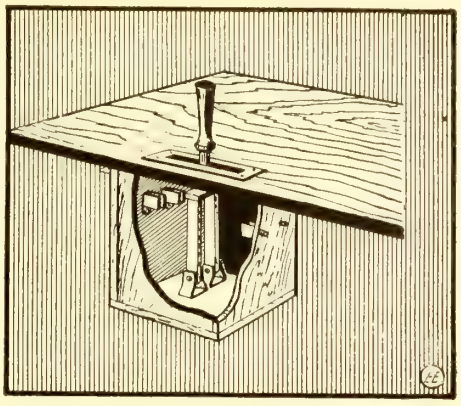
Two Methods of Utilizing Telegraph Relays as "Tikkers."

QUICK-THROW AERIAL SWITCH.

An aerial switch is an awkward thing on a radio table. It is always hard to place effectively. Here is a new way.

The ordinary double throw switch is used. Take it apart and mount in an enclosed frame, as shown in drawing. This frame is fastened to the under side of the table and the switch handle, by means of an extension, projects through a crevice in the table top. The slot is covered with a brass slide way, to give a neat appearance.

This method of mounting the "aerial switch" ensures increased speed and comfort in operation. It also has the much desired nifty "commercial" appearance. Contributed by EARL H. SWANSON.



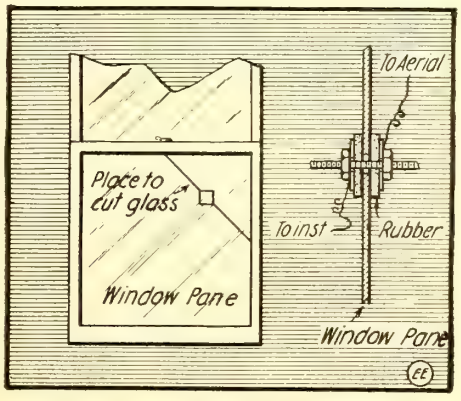
Nifty Form of Aerial Switch.

A SIMPLE EAR CUSHION FOR 'PHONES.

Many amateurs and even professional wireless operators often become very uncomfortable after listening for a long time on account of having the head receivers pressed against their ears. Many of them have purchased pneumatic ear cushions to overcome this, but a cheaper way is always patronized. Any person can construct these by taking a piece of rubber sponge about 2½ inches in diameter and about a half inch thick, allowing an inch on either side to fasten to the head-band clamp that holds the receiver; then punch or cut a hole about a half inch in diameter to allow the sound to reach the ear. It is now complete, and will also serve as an "ear muff" for the cold weather as well as a cushion. A piece of sponge may be bought for a dime in a drug store or novelty shop. Contributed by IRWIN DERSCH.

FILING GLASS WINDOWS FOR LEAD-INS.

In building my wireless station I had some trouble with the lead-in. I did not want to disfigure the window frame, so I decided to cut off a large corner of the window pane itself. Then I filed a notch in each piece large enough to receive my lead-in wire without touching the sides of the hole. I used a threaded copper rod for the lead-in. A rubber washer with a nut was placed on each side to keep out the air. The best way to file glass, without danger of breaking it if you are careful, is to hold it *completely under water* while filing the notches. I found this lead-in suitable for a 1 k.w. set. Contributed by WALTER FRANSEEN.

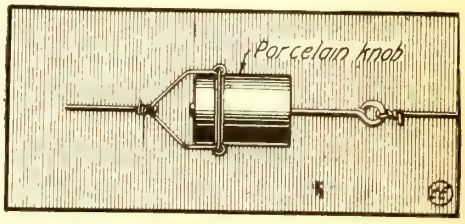


Way to Cut Window Glass for Lead-In.

PORCELAIN KNOBS AS STRAIN INSULATORS.

A simple method of using porcelain knobs as strain insulators is shown in the sketch herewith. A nail or piece of steel wire is arranged as perceived, so that it cannot be pulled through the center hole and a loop is formed of one end of the knob into which a guy wire or Antenna wire is secured. The second support from the insulator is made of a piece of wire clamped around the groove of same, as shown.

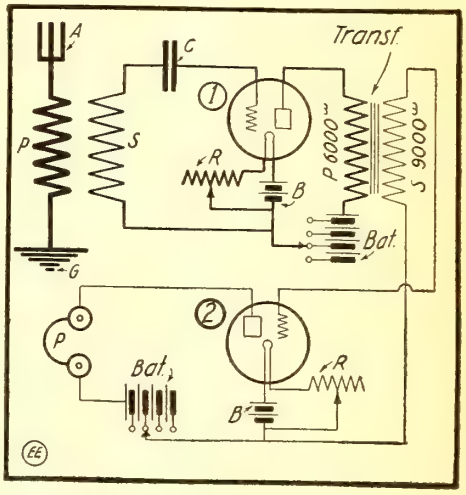
A number of these knobs may thus be placed in series, of course, in the usual way, to increase the resistance of the arrangement and to provide in this way, increased insulation value. Contributed by F. W. SULLIVAN.



Strain Insulator Easily Made from Porcelain Knob.

AN AUDION TRANSFORMER.

An Audion transformer has recently been put on the market by a well-known electrical concern, which is herewith shown. It consists of a primary coil wound over a soft iron wire core about 9 inches long and having 6,000 ohms resistance. Over this winding a secondary is made with fine wire (about 36 B. & S.) having a resistance of 9,000 ohms. This is then connected as outlined in diagram. The primary coil is connected to the first detector, which can be either of the crystal rectifying or Audion type, while the secondary is connected to an Audion detector in connection with a loud-speaking telephone for amplifying the incoming radio signals.



Audion Transformer Hook-Up.

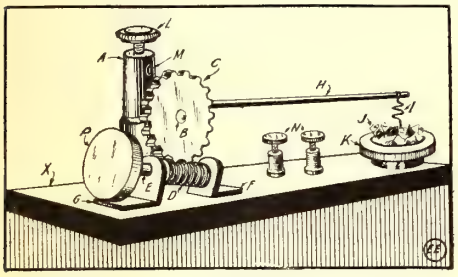
BRASS POLISH.

This formula consists of the following: 16 lb. *Crude Oleic Acid*, 5 lb. *Kieselguhr*, 4 lb. *Tasteless Mineral Oil*, 1½ oz. *Lemon Oil*. Mix the powders into a paste and gradually thin with the mixed fluids, being careful to prevent formation of lumps. Apply with a rag or waste, and when practically dry rub with another rag or waste.

A NOVEL DETECTOR STAND.

The illustration shows a type of galena detector which is capable of extremely minute and delicate adjustments.

The base X should be about 4x3x¾ inches. Locate a point on the base about 1 inch from one end and 1¼ inches from the side and fasten a large double binding post A to the base at that point. Next



Worm and Gear Adjustment for Detector.

obtain a piece of brass rod B, about 2 inches long, which should fit snugly the lower hole in A. On one end of B fasten a brass gear C. Drill a hole through the other end of B to take H, a brass rod about 3 inches long and a trifle smaller than B. Near the projecting end of H solder a small spring I, made of No. 20 brass wire, to make the contact with the galena crystal held in the cup K.

Cut a strip of 1/16-inch brass ¼ inch wide into two pieces ½ and ⅝ inch long, respectively. Drill two small holes near one end of each of these pieces to fasten them to the base. Near the other end of the longer piece drill a ⅛-inch hole, and near the end of the shorter one solder a small tack with just a little of the point left. Bend these brass pieces so as to hold the worm D in mesh with C, and also to give D a slight upward angle sufficient for the typewriter knob P to clear the base.

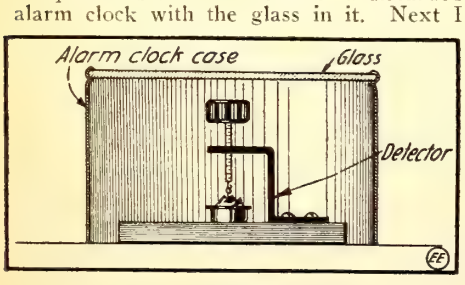
Make a slight indentation in the exact center of one end of D to turn on the tack soldered to F. This may be done with a center punch. Solder a ⅛-inch rod E to D. This rod passes through the hole in G, holding D firmly between F and G.

To assemble the whole suspend the worm D between G and F and secure them to the base with small round-headed screws. Care should be taken that D turns easily and does not bind. Pass the rod B through the lower hole in A. After placing the gear C in mesh with D tighten the set screw that clamps it to B so that C will turn, but will not move out of mesh with D. Wedge or solder the rod H in the hole in B. Secure the typewriter knob P to E and mount the binding posts N—N on the base and the detector is complete except for the crystal J.

Contributed by K. ROBERTS.

DUSTPROOF COVER FOR DETECTOR.

I procured the metal case of a discarded alarm clock with the glass in it. Next I



Alarm Clock Case Forms Efficient Detector Cover.

unscrewed the legs and the post which holds the bell, then I assembled it as shown in the accompanying sketch. The whole arrangement presents a very neat appearance, and the detector is always in view.

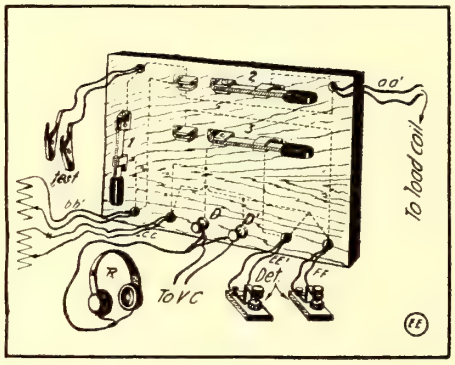
Contributed by J. WALLACE PECKHAM.

A WIRELESS RECEIVING "TEST" BOARD.

Many radio experimenters, when conducting tests, employ an extra receiving set, and during the operation usually cause the regular set to become deranged, thereby necessitating the rearrangement and putting together of the set every evening. However, by mounting the "test" board described below at some spot where it will remain unmolested and using flexible leads, the main apparatus will be left intact, while it will be possible to use both receiving sets at the same time on different wave lengths, if desired.

Two good points about this arrangement are that, instead of using binding posts, *long leads* in the form of stranded wire are brought out from the board through small holes. The leads to the aerial and ground have clips on their ends, which connect to the aerial switch blades.

The diagram is explained as follows: Switch No. 1 turns on test set; switch 2 cuts in or out a loading coil connected to leads A A^1, while switch 3 gives the choice of two detectors connected to E E^1 and F F^1. For connecting receiver tips, spring binding posts should be used at D D^1. A



Handy Test Board for Radio Receiving Station.

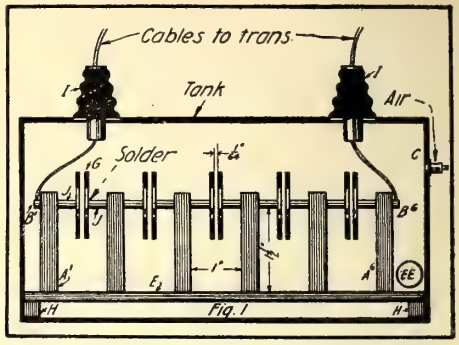
secondary loading coil may be connected at X.

Contributed by W. R. COTTRELL.

A COMPRESSED AIR SPARK GAP.

The average experimenter is not very familiar with the qualities possessed by the compressed air spark gap, due to the reason that it is seldom used. I present herewith the method of constructing a gap which radiates a sharp, pure wave, very similar to the well-known quenched type. If constructed right it will give as much satisfaction as a quenched gap and is, besides, much cheaper to build.

Obtain a heavy metal can about 6x3 inches, and two spark plug porcelains; in my case these were 2x¼ inch. Through the top of the can (Fig. 1.) bore two holes which have a diameter large enough to admit the insulators I. Cut out of hard rubber the base E, which measures 6x1 inch. Bore five holes, each hole being 1 inch from the other and large enough to admit an 8/32 machine screw. Cut out of ¼-inch brass rod (five) or six standards A, each 1½ inches high. Drill a 3/32-inch hole for ¼ inch up into the standard. At the top of the standard also drill a 3/32-inch hole at right angles to the length of it and which extends through same. This drilling having been done on the other four, they are screwed into place on the base so as to have the top holes in a line. Ten zinc discs G, 1 inch in diameter by 1/16 inch thick are turned out and are welded or soldered to the threaded rods J, as per illustration, so as to face each other. The discs G should be 1/64 inch apart. The rods J should be, when adjusted, soldered to the standards B. The gap thus being completed, should now be mounted on two blocks H, which measure



This Spark Gap Utilizes Compressed Air, with a Gain in Efficiency.

1x¼ inch high by ¼ inch thick. Take care not to have any metal part of the gap touch the can. The posts H may be glued onto the can so as to hold them in place. A No. 8 copper wire should be run through both insulators I, long enough to run to the transformer and reach the standards B_1 and B_6. This being done, the space left in the insulator should be cemented up. In some convenient place on the can bore a hole large enough to admit the air valve C, which may be of the bicycle tire variety. Solder the valve to the can and cement a 1-foot length of the right size rubber hose to the valve.

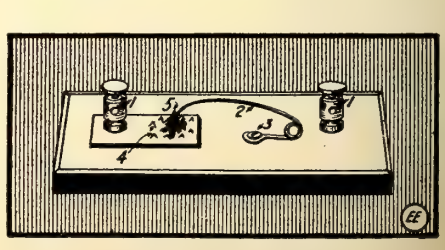
The most important thing is to reinforce the can by recementing and resoldering all metal joints (solder the cover on very firmly). Be sure to cement up joints where holes have been drilled. The whole gap is next immersed in hot sealing wax so as to completely cover can, the thicker the cement and wax film is the better, taking care not to get the air hose leading from the valve C clogged. For cooling purposes immerse gap in oil. By referring to the drawing all omitted details may be found.

Operation: Attach tire pump to valve hose and pump in at least 40 pounds of air. The pressure may be obtained by a tire gauge. Do not have more than 50 pounds pressure or the experiment will likely prove decidedly disastrous.

Contributed by H. SMELTZER.

A "SAFETY-PIN" DETECTOR.

Here is a sketch of how to make an efficient and substantial detector from a safety-pin. The drawing speaks for itself. (*Safety first!! Ed.*) 1 and 1 are the binding posts; 2 is the safety pin cut and bent as shown; 3 is the screw to fasten it to the base, and from there runs a wire to one binding post. At 4 is a piece of brass



A "Safety-Pin" Detector.

perforated to make a rough base, so that the mineral 5 will not slip.

Contributed by LOUIS H. BUEHL.

The RADIO LEAGUE of AMERICA

HONORARY MEMBERS
CAPT. W.H.G. BULLARD, U.S.N. NIKOLA TESLA.
PROF. REGINALD FESSENDEN. DR. LEE DE FOREST.

Manager, H. Gernsback

IT is with the greatest pleasure that we report the exceedingly large response from prospective members to the RADIO LEAGUE OF AMERICA.

When the December issue first appeared we had an idea that the movement surely would be endorsed by a great many wireless amateurs, but we did not expect the extraordinary support which has been experienced up to this writing. Every mail brings dozens of applications, and there seems to be no let-up whatsoever; quite the contrary, the replies seem to increase daily. Present indications are that before the month is over the LEAGUE will have considerably over 5,000 members.

This response of patriotic wireless amateurs is certainly more than gratifying, but we are quite certain that we are only at the beginning and that within the next two months, when the movement becomes better known, that the response from the amateurs will become still more insistent. We have heard from every corner of the Union and from almost every city of any importance. A very encouraging result is that the parents of the younger boys are very much interested in the movement, there having been received hundreds of letters from them congratulating the LEAGUE upon the movement.

If by any chance you should not have seen the December issue carrying the announcement of the RADIO LEAGUE OF AMERICA, we urge you by all means to send for that number, as it explains the movement in detail.

While we thought we had stated everything in plain language, in the announcement we have been asked quite a few questions which we try to answer here.

Many prospective members desire to know if it is necessary for a member to be of age in order to be eligible. The answer to this question is that *anyone* born in the United States is eligible as a member, providing he is at least 14 years old.

Although we stated the fact, and although reproduction of the membership certificate in our December issue shows it clearly, there have been quite a number of inquiries if there are any dues to be paid in order to become a member. To this we again would state emphatically that *there are absolutely No Dues whatsoever to be paid* and that anyone born in the United States or anyone who is an American citizen can become a member of the LEAGUE.

Quite a few prospective members wanted to know if more than one application would have to be filled out in case the station was owned jointly by two or more amateurs.

Answering this question, it has been decided upon that where two or more persons own a wireless station, each will be entitled to become a member, providing the back of the application states this fact. Thus on the back of the application the following line should be written and signed:

The above instruments are owned jointly by: (Insert here the names of parties owning the station.)

There seems to be some misapprehension in the minds of most persons as to pledging their stations to the Government in case of war. A number of prospective members have an idea that in case they pledge their station to the Government they thereby automatically pledge themselves and their services to the Government. Nothing could be more wrong.

In this case the owner would be pledging his station to the Government in the same manner as he would pledge his automobile to the Government while he himself would not necessarily have to serve in the army unless he expressly desired to do so.

We call particular attention to the annexed blank published at the suggestion of Capt. W. H. G. Bullard, U. S. N. After carefully reading its contents it will be apparent that even though you do pledge your services to the national Government, *you are at liberty to withdraw this pledge at any time you desire to do so.* While this would, of course, not be a very patriotic act, the Government realizes that not everybody who pledges himself for service now can possibly be expected to do so five or 10 years hence. Conditions may change, as well as health, etc., which may make a future withdrawal not only logical, but it may, indeed, be to the benefit of the country.

As to pledging the station to the national Government, the underlying idea of this is that in case of necessity the Government could count upon using your station should it become necessary for the welfare of the country to do so. It, of course, would not matter whether you were there to operate your station or not. In this case your station would be used in the same manner as the Government would use a private telephone or telegraph line which it would operate in war time the same as if it belonged to the Government.

The manager will at all times be glad to answer any questions pertaining to the movement which are not entirely clear to prospective members.

The following letter has been received from Capt. W. H. G. Bullard, U. S. N. We urge every LEAGUE member, as well as every prospective member, to read it carefully:

NAVY DEPARTMENT,
U. S. NAVAL RADIO SERVICE,
Office of the Superintendent.

RADIO, Va., November 23, 1915.

Mr. H. Gernsback, Editor, THE ELECTRICAL EXPERIMENTER, 233 Fulton Street, New York:

DEAR SIR: In reply to your letter of November 22, 1915, which I have read with much interest and for which I wish to thank you in connection with your offer to co-operate with this Service in obtaining volunteers for the Naval Radio Service in time of war, I am enclosing herewith a copy of the original circular letter drawn up by this office, changed in some respects so as to suit the circumstances, and which I shall be pleased if you will publish in your magazine.

Very truly yours,
W. H. G. BULLARD, Captain, U. S. Navy,
Superintendent of Radio Service.

NAVY DEPARTMENT,
U. S. NAVAL RADIO SERVICE,
Office of the Superintendent.
RADIO, Va.

SIR: The necessity of having a list of experienced radio operators who would be available for service on naval vessels and all naval shore radio stations in time of public peril is very evident, and it is desired to obtain the names of such men in times of peace, and to revise the list from time to time as required, so that the Navy would not suffer from lack of operators or delay in training them, when the necessity arises.

The form attached should be filled out and mailed to the Superintendent of Radio Service, if you will signify your intention to offer your services to the Navy as a radio operator as outlined in the first paragraph of the form.

This will in no way interfere with your occupation in time of peace, and can be withdrawn at any time, should you so desire (see last part of paragraph 11 of form).

Referring to paragraph 7 of the form, it will be the intention as far as practicable, in accordance with your qualifications and the needs of the service, to assign you to the duty for which you express a preference.

The Navy will offer an opportunity to operators to continue in their chosen profession and at the same time give them an opportunity of serving their country in its hour of need. This latter, it is believed, should be a determining factor in assisting you to decide to offer your services to the Navy at that time.

The office of the Superintendent will be very glad to furnish upon your request, any further information in regard to this important subject.

The enrollment of your name among those who signify their intention to serve the country when required for the national defense will be of great assistance in the efforts the Navy is making to carry out its policy, "In time of peace prepare for war," and in this policy, you, as well as every American citizen, should be deeply interested. In the particularly important branch, the Naval Radio Service, you will not only show your interest, but will aid in making it effective by a declaration of your intentions to offer your services.

Very respectfully,
W. H. G. BULLARD, U. S. N.

[NOTE.—If you do not wish to tear this page out of the magazine you can make a copy of the form on a sheet of white paper. The questions should be filled in carefully and the blank sent to Radio, Va.]

(Place).....

(Date).....

Superintendent U. S. Naval Radio Service, U. S. Naval Radio Station, Radio, Va.:

SIR: 1. In the event of the United States needing my services as radio operator, owing to exigences due to public peril, it is my intention to offer my services to the Navy Department as a radio operator during the time for which the exigency exists, according to such regulations or laws as may be in force at the time covering enlistment in the Navy.

2. I am a citizen of the United States
3. My age is at the present date
4. My present address is
5. My home address is
6. My present occupation is
7. My preference for duty is (state ship or shore station)
8. I hold a license as radio operator issued by the Department of Commerce with number, date and class as given
9. My experience in radio telegraphy is as follows: (State briefly experience in operating radio sets, names of stations, ship or shore, with types of apparatus. Also give any experience with land telegraph or cable companies, and any other qualifications in reference to ability as operator).
10. I can send in Continental Morse Code, ... words; American Morse Code, ... words; I can receive in Continental Morse Code, ... words; American Morse Code, ... words.
11. In case of any change in the information given under 4 and 5, or if for any reason it becomes necessary for me to change my views concerning my present intentions, as expressed in paragraph 1, I will so inform the Superintendent of Naval Radio Service.

Very truly yours,

Name .....

Address.....

This letter was received from Dr. Lee de Forest. Its importance will be appre-

(*Continued on page* 501.)

THE CONSTRUCTOR



How to Make a Simple Static Machine

By E. F. Hallock

THE experimenter, especially the fellow who dabbles in things electrical, oftentimes finds himself in a bad way for want of a static electric machine of one sort or another. Just why he should go without is a mystery; for, while the machines on the market are, for the most part, 'way beyond the reach of the average experimenter, so far as price is concerned, anyone who is handy with tools can make



A Simple Static Machine Constructed from Phonograph Record and Other Everyday Materials Found About the House.

a real serviceable frictional electrical machine in a few hours' time. And, far from being complicated, the construction of the machine is the acme of simplicity. The materials to be used are right at hand in most workshops, all save the disc itself, which is nothing more nor less than a simple phonograph record, made of hard rubber composition or vulcanite.

Just why the hard rubber disc is used, instead of the more commonly employed glass will at once be apparent to the experimenter who has endeavored to , or perhaps has, cut out a nice, perfectly round disc of glass, and ground the edge to a fine finish, only to break the fragile material when it came to drilling the hole for the passage of the mandrel or spindle. The record is all prepared; perfectly shaped and ready "drilled," and, after all, is just about as good a dielectric as the glass and in every way suited to the work it is to perform in connection with the electric machine.

The photograph gives a very good idea of the appearance of the finished machine, and comparison with the six-inch pliers shown in the foreground will give a good idea as to the relative dimensions of the various parts of the machine. In connection with its serviceability, it might be well to point out that this little machine will give a spark well over 2½ inches long, when used in connection with the small Leyden jars shown, and that the character of the spark can be varied from a sharp, snappy crackling spark to a wide brush discharge. For igniting gases, demonstrating electrical principles, illuminating Geissler tubes and a variety of other experimental uses, this simple machine answers all requirements.

The base is a piece of wood about three-quarters of an inch thick, roughly 15 inches long and nine inches wide. Hard wood is preferable to soft, and close-grained wood to the open-grained variety. For appearance sake it should be neatly planed, the edges beveled somewhat, and the whole smoothed off with sandpaper. Of course it can be painted; but, in view of the fact that most paints are made from a base of white lead, which is an electrical conductor, it is best to varnish the base, preferably with shellac, so as to preserve it from moisture.

In the machine shown the standards through which the mandrel passes are turned on a lathe, but even this is not necessary, for perfectly plain uprights will do just as well and will not be far behind the more ornate ones in appearance. These standards are about nine inches in height and the shaft is journaled in babbit bearings cast in them.

The phonograph disc is prepared by sandpapering the record side down till the surface is perfectly level, using finer sandpaper after the greater part of the lines has been removed. The surface is then given a polish with rouge cloth, so that both sides are perfectly smooth. The disc used is 10 inches in diameter.

The electrical effect is created by means of a rubber, or a pad of silk mounted on a fork, which, in the illustration, is hidden from view by the handle of the machine. This silk is stretched tightly over a packing of silk trimmings, so that the inside surfaces of both branches of the fork are covered; the fork, which is made of brass, straddles the disc, so that the pads are in contact at all times with both surfaces of the record. The fork is supported from a brass ball, in turn mounted on a hard rubber rod. The latter is held firmly in place by means of a wooden cup turned for the purpose and firmly attached to the base of the instrument, as perceived.

A similar arrangement of insulating rod and ball supports a brass collecting ring at the opposite side of the disc. This ring, which is rounded and free from sharp edges from which the current escapes more readily, is provided with a number of sharp points on the side facing the disc, which *very nearly* touch the surface of the plate.

The plate is mounted on a shaft of Bessemer (machine) steel, a few nuts and washers serving to hold the plate firmly to the shaft, which is threaded from one end to the middle to provide the bearing for the nuts. Care should be taken in mounting the plate perfectly true. The handle can be formed simply by bending the rod to form a crank, though in the machine shown a built-up handle was used.

Jelly glasses form the better part of each of the Leyden jars. The glasses are coated with tinfoil half-way up on both inside and outside surfaces. Hard rubber tops should be used, through which protrude brass rods provided with short lengths of brass chain at their lower ends to form the contact with the inner coatings of the jars. Similarly, chain is used as a ready means of connecting the jars to the respective sides of the machine.

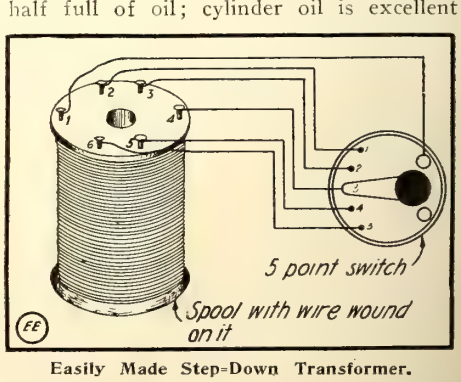
As was said before, the whole machine can be made within a few hours' time, but for all its simplicity it is effective. Its operation is improved somewhat, and at the same time the life of the silk pads is increased if the pad is rubbed with a small quantity of amalgam made of zinc and mercury.

LEATHER DRESSING.

An effective rain-proof leather dressing can be made as follows: To 2 parts of *Common Glue* liquefied by heating, add 3 parts *Castile Soap;* dissolve by heating together with 120 parts *Water,* stirring until a good mixture is obtained. Add 4 parts *Spirit Varnish,* and then mix 2 parts *Wheat Starch* with *Water* and throw in. For black leather sufficient *lampblack* can be added without killing the gloss of the dressing.

HOW TO MAKE A STEP-DOWN TRANSFORMER.

First obtain ¼ lb. of cotton covered No. 36 gauge copper wire, which comes on a tin spool which you will need later. Unwind the wire and then rewind it, tapping off six places at equal distances to control the current. It is best to number the taps as you wind the spool, the first, No. 1; second, No. 2, etc. Now place the tin spool and coil in a pint fruit jar and fill it one-half full of oil; cylinder oil is excellent



Easily Made Step-Down Transformer.

and can be procured at a garage at a small price. Placing the coil in oil prevents it from becoming hot. The next step is to connect the spool to a five-point switch, as in the diagram, and the coil is ready for use. It should be connected to the apparatus it is to operate in series with the 110-volt lighting current.

Contributed by
ALEXANDER V. BOLLERER.

Electrical Helps for Amateur Photographers

By P. Mertz

HERE are, doubtless, quite a few readers of *The Electrical Experimenter* who dabble in photography. These frequently find it of great advantage to be able to apply their experience with electricity to the taking and making of pictures. It is for them that this article has been written, and it is hoped that it may be of some benefit.

1. An Electrical Shutter Release.

There frequently come up cases when

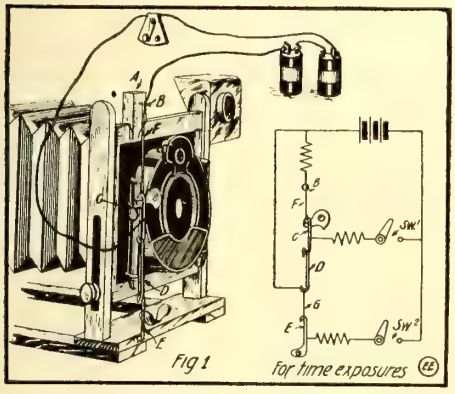


Fig. 1. Electric Fuse Arrangement for Releasing and Closing Camera Shutter.

the photographer cannot stand near the camera to release the shutter, such as when he wants himself to be included in the picture, or, in bird photography, or in a number of other circumstances.

There are several devices for this purpose, each with its advantages and its disadvantages. The writer has devised an apparatus, which has given perfect satisfaction, and which he believes has some advantages over the others.

Its principle of operation depends upon the melting of a fine (No. 40 B. & S.) iron or copper wire, which releases a spring or rubber band, which, in turn, trips the shutter.

The details of construction, as devised for adaption to a 3A Kodak, fitted with automatic shutter, are shown in Fig. 1. A wooden bar A has a slot cut in at the bottom, and fits closely on the lens-board between the front upright and the bellows. It holds a nail or screw B. A piece of wire C is bent into shape and fitted on the finger release. A strong rubber band D is hooked on to the lower end of C. For instantaneous exposures the lower end of the rubber band is hooked on to another piece of wire E, which itself is hooked to some part of the frame. One end of the fine wire F (of iron, if possible, as it will require less battery; and size No. 40) is twisted around C, the other end around the nail B, its length being so adjusted that it just prevents C from tripping the shutter. At the time of exposure a battery current is turned on between B and C; which will melt the wire and allow the rubber band to pull down the finger release.

If a time exposure is desired, the additional fine wire G (shown in the supplementary illustration) should be attached between the rubber band and the frame, and the shutter set at BULB (*not time*). Wire F is fused first, and, after the required time has elapsed, wire G is fused.

For the connections, annunciator wire or flexible cord of the same size are very good—a too fine wire should not be used, as it will reduce the current appreciably. Care should also be taken to use the smallest possible amount of connecting wire, as too much of this, also, will tend to weaken the current.

The switch used should preferably be of the lever type rather than the push-button type, as, unless a heavy current is used, the fine wire does not fuse instantaneously. If it is not inconvenient to keep up the pressure for a second or so, however, a push-button may be used. For time exposure, two switches are required, as shown in the illustration.

As to the amount of battery required, I have found one dry cell to be sufficient, although two would be better. A flashlight battery of three cells may be used if the wire to be melted is very fine, *short* and of iron, and the connections rather short and heavy.

The device has been described for use with only one make of shutter, as there are too many different types used. The use of a little ingenuity will, however, enable the "electrician-photographer" to devise one for his own particular make of shutter and camera.

2. An Electrical Flashlight Apparatus.

It is frequently convenient to set off a flashlight from a distance. For such purposes an electrical arrangement is extremely useful. However, the usual method is to use a spark coil and have the spark ignite the flashlight powder. A much simpler device is to use (as in the preceeding article) a piece of fine iron or copper wire, which will become red hot when the current is turned on and ignite the magnesium mixture.

The powder is put into the cover from a tin can, which itself is on a board (see Fig. 2). Two nails are driven into the board, on each side of the tin cover, so as to hold two pieces of fairly heavy wire, between which the fine wire to be fused is attached. It should be arranged so that the middle of it will just touch the top of the heap of magnesium powder.

In order to obtain better results, the powder should be stretched along a length of about 10 inches or a foot on a metal plate. Still better results may be obtained by putting a fairly large cheesecloth screen in front of the flashlight, but then more powder is required. This last method is the one usually employed by professionals.

If desired, the electrical shutter release may b used in connection with this device, and flashlights may then be taken inside in the daytime. The operator simply releases the shutter a few seconds before the exposure, then sets off the flashlight and closes the shutter.

The details regarding the connections are the same as for the shutter release. It will be found, however, that a little less battery will be satisfactory, as the fine wire does not have to be melted, but merely heated red hot.

3. Handy Uses for Electric Lights.

Electric lights are very handy things for the photographer.

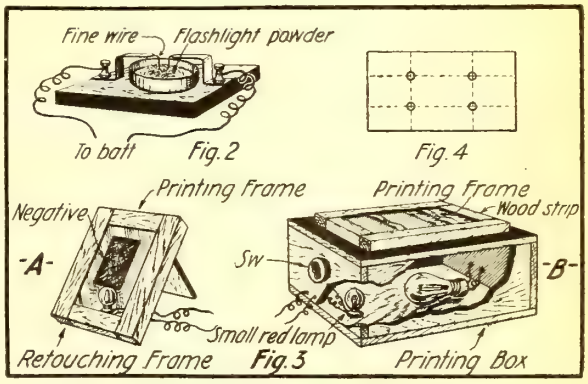
A retouching frame can easily be made, as shown at A in Fig. 3, by taking a printing frame several sizes larger than the negative, and laying it on a table with either part of the back swung out, so that it raises the whole above the table, and gives the surface a slanting position, easy to work on. Then a small electric light bulb underneath, on a piece of white paper, allows one to see the work distinctly. Before retouching, the negative should be treated by painting it with a thin coat of varnish made by dissolving a little rosin in turpentine.

A convenient printing box (see B, Fig. 3) may be made by taking any wooden box of reasonable size (as compared to the size of the printing frame), and cutting a rectangular hole on top, the size of the *opening* in the printing frame. Strips of wood are then nailed on the box so as to closely fit the frame, in this way preventing light from coming out. (This is to permit the box to be used in the dark room.) A Mazda lamp of a size depending upon that of the print is placed inside the box, the connecting wires being carefully brought in through holes, finally packed with putty to prevent light from leaking out. A switch of any convenient type is fastened on the outside of the box, for turning the light on and off.

In use the box should be placed near the developing tray, with the light turned off. A negative is put in the frame, a sheet of printing paper placed on top of this, and the back clamped down over the two. The light is turned on, left on the required time, then turned off. The print is now taken out and developed. As soon as this is completed it is rinsed and dipped into the hypo and another print started. This permits of very fast work, and yet each print is perfect. If desired, a small red light may also be put inside the box so as to help in adjusting the negative over the mask.

A help in developing (when using transparent trays, such as glass or amber composition) is to stand the tray on two strips of wood and put a miniature incandescent lamp (dyed a very deep red) underneath. The formation of the image on the plate, as development proceeds, can then be observed better than with the ordinary dark room lamp.

Another great help in the dark room is a "fountain pen" flashlight, with the little bulb dyed a very deep red. This allows one to get at bottles, trays, etc., lying around on shelves or elsewhere, without having to either grope in the dark or disturb the regular dark room lamp.



Figs. 2, 3 and 4 Showing Several Useful Electrical Ideas for the Amateur Photographer.

4. Taking a Picture of the Wireless Set.

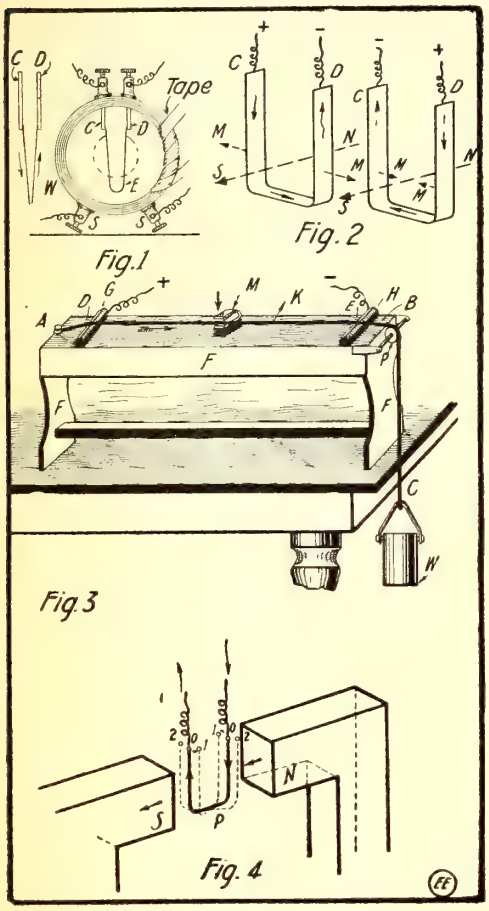
Many an amateur would like to take a picture of his own wireless set, but after the first trial the results are usually so poor (unless he has had a little more experience than most fellows) that he seldom has the incentive to try again.

This is because taking a picture indoors, usually in front of a window, where every-

(*Continued on page* 521.)

SIMPLE ELECTRO-MAGNETIC DEMONSTRATION APPARATUS.

The apparatus described below demonstrates very effectively several important electro-magnetic principles of great importance. The exact dimensions make little or no difference and the cost is very small.



Easily Made Apparatus for Demonstrating Electro-Magnetic Phenomena.

Let us take the instrument as shown in Fig. 1. It consists of a coil about 2½ inches in diameter and made up with 100 turns of No. 24 B. & S. cotton-covered or enameled copper wire. This coil is wrapped all the way round with linen tape, with the exception of a space about 1½ inches long at the top. The coil can be mounted in any manner in an upright position and the ends brought out to two binding posts.

Separate the turns carefully where the coil is untaped and insert the two binding posts with extensions C, D, shown in the illustration. Between the ends of these extensions is fastened a very thin sheet of metal foil. Gold leaf is the best; a piece ¼ inch wide and 2 inches long will do and can be attached to C and D by slightly moistening them and pressing the foil carefully in position. It is advisable to place the instrument in a bell jar or similar arrangement to protect it from draughts.

One or two dry batteries will be sufficient for the experiment. One should be used at first, and more added as found necessary. The one set of batteries may be used for both circuits.

Connect all the batteries to the coil and connect one or two to the posts connected with foil. The magnetic field formed by the coil will pass through the loop at right angles as shown in illustration. If the current is passed through the foil strip as shown by the arrow "F," the loop will open out to form a circle (see dotted lines, Fig. 1). Should the current be sent in the opposite direction, the loop will collapse. This effect can also be produced by reversing the current in the coil.

The current should be shut off immediately when the gold leaf collapses, or the battery will be run down or the gold leaf damaged. Reversing the current for a second will spread the loop again, and it is much better than attempting to open the loop with the hands.

So much for the effect. Now for the cause. This can be best understood by imagining the lines of magnetic force created by the coil as pieces of stretched rubber that have a tendency to shorten and so spread sideways. When current flows in the loop as indicated in Fig. 2, the field inside the loop is strengthened and that outside weakened, and the loop is forced outward to form a circle. The opposite is the case when the current is reversed; the field inside is neutralized or weakened and that outside strengthened, and the two sides are forced together.

Another experiment showing nicely the behavior of a wire carrying an alternating current in a magnetic field may be made by arranging the apparatus shown in Fig. 3. This apparatus is to be used in connection with 110 volts alternating current.

If we mount a copper wire A B C as in Fig. 3, stretching it along some such wooden framework F as that sketched and carrying it over a free-running pulley P to a loading bucket W, we may pass current through a length D E of the wire by making the bridges G H, which hold the wire clear of F, of metal, and using them as terminals. Current taken from lighting mains must, of course, be passed through a 16 or 32 cp. lamp as when charging accumulators, and care must be taken to avoid shocks and short-circuits.

At the center of the wire mount a small permanent magnet M so that its poles lie above and below the wire, but not touching it. When current passes along the wire in the direction shown the wire will be moved electro-magnetically in direction K. If the current be alternating, the wire will swing to and fro in a horizontal direction with the same frequency as that of reversal of the current.

As the apparatus is first set up, it will probably be difficult to observe the vibration of the wire, because the current reverses so often that the wire has not time to move far before it is pulled back again. It is a very simple matter, however, to magnify the motion of the wire so that it becomes very noticeable. The wire thus mounted has a "natural frequency" of its own (indeed, readers who have experimented in sound will recognize this apparatus as the "sonometer" applied to a new use). This natural frequency depends on the material and size of the wire, the length of it between the bridges G H and the tension on the wire. When the natural frequency of the wire is the same as the frequency of the electro-magnetic alternations which vibrate it "resonance" takes place, and the swing of the wire becomes quite considerable. The most convenient and gradual way of varying the natural frequency of the wire (so as to "tune" it to the supply frequency) is to increase the tension on the wire by pouring water into the bucket W. Using 2 or 3 feet of No. 24 copper wire between G H, Fig. 3, it will generally be found that a two-quart can is a suitable size to hang on the wire at C, assuming 60 cycles per second alternating current to be employed. Having switched on current, pour water slowly into C till the swing of the wire attains a maximum. Variations in the supply frequency will then be shown by variations in the width of "blur" made by the quickly moving wire. It is possible, but not easy, to calculate the supply frequency from the length, size and load of wire with which resonance is attained.

The same phenomenon of electro-magnetic vibration may be demonstrated in another effective way, and without making any special apparatus, by placing between the poles of a direct current electro-magnet or permanent magnet, or between two bar magnets in "series," an electric glow lamp supplied with alternating current and having one or more loops of filament, which loops are now placed *parallel* to the magnetic field and not perpendicular thereto as in our first loop experiment. Referring to Fig. 4, it is clear that when current flows as shown the filament loop O P O will tend to twist in the direction 1 P 1; and when the current is reversed the loop will tend to move to 2 P 2. If lamp current and magnet field be reversed simultaneously (by connecting lamp and magnet coils in series) the lamp filament will remain stationary. In the lamp the points OO of the filament are fixed; but if the lamp is a high voltage, low candlepower lamp—i. e., if the filament is long and slender—it will twist very appreciably (sometimes through 30 degrees or so) under the action of the alternating electro-magnetic forces. This will give the appearance of a broad, bright band at the sides of the loop, the point P (Fig. 4) remaining stationary. A very pretty effect is obtained by using a three-loop lamp. If the filament be wound in the shape of a drum, or in any other shape than a U-loop or number of parallel loops, its motion in the alternating field will be complex, but very interesting. Some lamps will show the vibration better than others, and the filaments which vibrate through the widest angle will break soonest. (This particular experiment is not calculated to reduce lamp bills, and is apt to be unpopular on that account.)—*Junior Mechanics and Electricity.*

AN ELECTRIC TRAP FOR CATS, ETC.

The electric circuit through this trap is as follows: From binding post A, through contact spring S, through one hinge of door to upright W, then through trigger and armature, through electro magnets M, and then to binding post B.

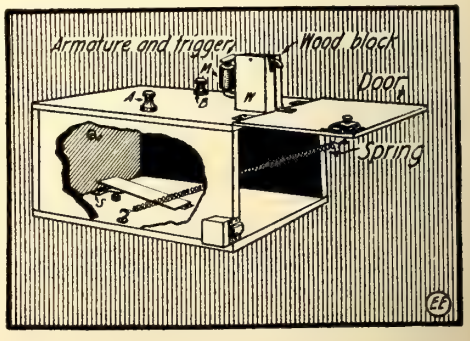
The contact spring may be placed on bait hook if desired instead of under board.

This is a very efficient trap, as the contact is so much more easily closed than the *figure-four trigger* or any other kind. The trap will serve as well for birds as for animals.

Battery is connected to binding posts A and B. There are no dimensions given, as the trap can be made in any desired size. For large traps an ordinary electric door opener will do very well for a trigger.

Contributed by

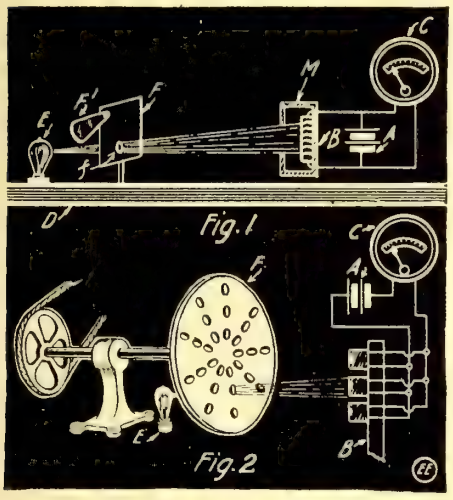
J. E. HENDERSON, JR.



Simply Constructed Trap With Electrical Release Magnet for Door.

A SELENIUM PHOTOMETER.

The inaccuracies of the photometric methods now in common use are well known. In many cases differences amounting to as much as 10 per cent. will exist between the estimates made by different observers with best available scientific means of comparison. Furthermore, the colors of the lights to be compared are of great importance. The colors differ in the intensity of the effect produced upon the eye of an individual, and there is a marked variation between different persons in this respect. By some observers two lights of the same color may be compared with considerable accuracy, but a change in the color of the standard with the common standard of comparison (the now well-known "Pentane Lamp") will render the determination worthless. The color of the standard lamp is toward the red end of the spectrum, and to most eyes it shows decidedly pink. Hence, when an attempt is made to compare a yellow incandescent lamp, for example, with the standard, the results obtained from different observers are often so discordant as to make them of little use.



Simple Form of Selenium Photometer.

To obviate all these difficulties William J. Hammer has devised and patented a very simple and ingenious photometer in which the sensitivity of selenium to light is practically applied.

In Fig. 1 A is the battery connected in a circuit with a selenium cell B, which is preferably of that form in which the selenium, after being coated upon a suitable conducting support, such as a coil of nickel wire, is sealed in a tube of nearly perfect vacuum. C is a measuring instrument, being in the case illustrated a milli-voltmeter, responsive to small variations of electrical pressure.

Upon a suitable table D is arranged the lamp E to be tested. At F is a screen having a hole f, which may be closed by a slide F_1; in practise it is preferable to place the selenium cell in a light, tight box M having free ventilation, so that the indication may not be affected by exterior light.

The method of operating the arrangement thus described is as follows: A standard lamp of any desired construction is placed in a proper position adjacent to the apparatus lighted, being screened, completely from the cell B. A small current is then caused to flow in the circuit, including the selenium cell, and after it has attained a steady value the fall of potential around the cell is measured by the milli-voltmeter. After this the light of the standard lamp is allowed to fall upon the cell, and the change in the resistance of the circuit (as indicated by the change in the voltage drop), caused by the action of the light upon the selenium, is measured and recorded; this then becomes a constant for the particular "cell" employed. After this the light which is to be compared with the standard may have its specific effect upon the cell determined in the same way. Obviously, the indication of the cell for the first specimen constructed must be calibrated by comparison with the results obtained by photometers, since the measurements of light now in use are purely arbitrary and have no relation to any definite physical quantity; but this relation having been once established in the manner indicated, may be indefinitely perpetuated by periodic comparison of different cells to guard against change.

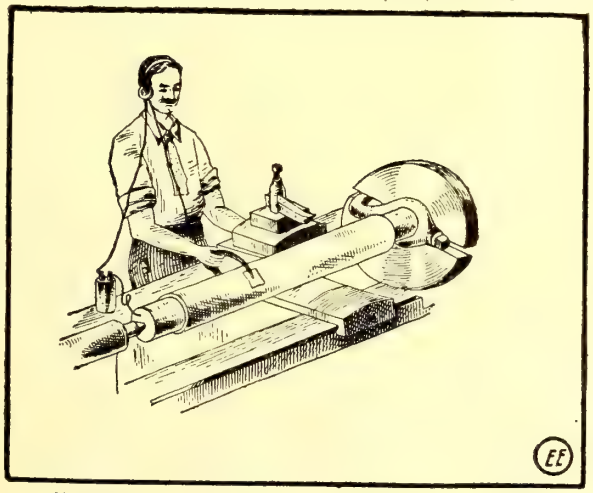
Another good arrangement is shown in Fig. 2. In this figure the cells B are arranged upon a stationary support and the screen disc F alone rotates, cutting off and admitting the light periodically by its rotation. This construction is cheaper, and yet substantially effective. This is another practical use of selenium.

Contributed by
HOMER VANDERBILT.

TELEPHONE RECEIVER AIDS THE MACHINIST.

A telephone receiver has been my constant friend about the plant for the past 12 years, says A. J. Carr, in *Power*. I use it for various purposes, one of which is in connection with calipering, especially the work inside of engine cylinders. The most convenient way is to have the two sides of the calipers insulated from each other. In the illustration, where the work in the lathe completes the circuit, causing a click in the receiver, an ordinary pair may be used with a cigarette paper between the work and one side of the calipers. This method is especially useful in aligning engines.

Use a slender German silver wire for the "center" line, taking care that it is insulated from the ground if an ordinary caliper is used, or put a cigarette paper next to the cylinder wall; then, with one side of the circuit connected to the aligning wire and the other to the calipers, a circuit will be completed when the two come in contact. A click will be heard when a contact is so slight that it cannot be seen or felt. Care should be taken not to use too much battery power, as it is annoying to the ear.



Telephone Receivers Aid the Machinist to Calliper.

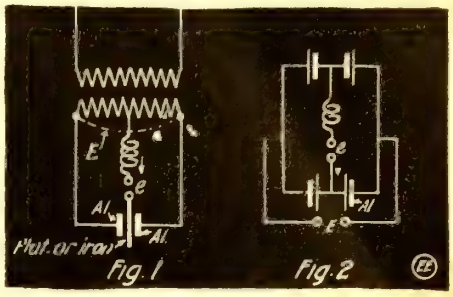
Brass Cleaning Paste.—The following makes a good cleaning paste: *Rotten Stone*, 6 ozs.; *Oxalic Acid*, 1 oz; equal parts of *Whale Oil* and *Spirits of Turpentine* sufficient to make a paste.

A general metal polishing paste may be made as follows, the quantity of the parts being by weight: *Petroleum Jelly* (white), 90 parts; *Kieselguhr*, 30 parts; *Refined Paraffine Wax*, 10 parts; *Refined Chalk* or *Whiting*, 10 parts; *Sodium Hypophosphite*, 8 parts. A little *Citronelle* can be added to cover up disagreeable odors and scent to paste.

A polishing powder may be made as follows, the quantities being by weight: *Putty Powder*, 14 parts; *Pipe Clay*, 14 parts; *Kieselguhr*, 42 parts; *Tartaric Acid* (powdered), 1½ parts.

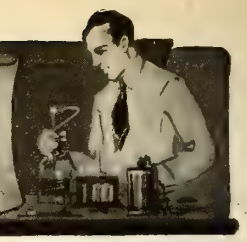
ALUMINUM RECTIFIER EFFICIENCY

In a recent article Günther Schulze discusses what maximum efficiencies may be expected from electrolytic rectifiers with aqueous solutions. The efficiency is limited by three kinds of losses. The first loss is due to the fact that a certain minimum voltage must be reached before the current will pass in the permissible direction. This minimum voltage is a function of the formation voltage of the aluminum plates. The second loss is caused by the ohmic resistance, and the third by the fact that the impermeability of the rectifier (in the direction opposite to the permissible direction) is not perfect. The last two losses may be made small, but the first loss due to the minimum voltage cannot be reduced at will. The author makes the calculations for two arrangements of the rectifier. The first, shown in Fig. 1, is the transformer system in which *E* is the transformer and *e* is the available direct-current voltage. *Al* represents the aluminum plates, and between them is a platinum (*Pt*) or iron (*Fe*) plate. The second system discussed is the Graetz system, shown in Fig. 2, in which *E* is again the alternating voltage and *e* is the available unidirectional voltage. In both cases an induction coil is inserted in the direct-current circuit to make the voltage practically constant. The author first determined the minimum voltage as function of the formation voltage for different electrolytes and calculated the maximum voltage obtainable both for the transformer system and the Graetz system. In both cases the possible efficiencies reach a maximum which is from 80 to 85 per cent., but this maximum is reached for a unidirectional emf. of from 60 volts to 80 volts for the transformer system and for from 100 to 150 volts for the Graetz system. For small voltages the maximum possible efficiencies are low. For a unidirectional emf. of five volts the maximum possible efficiencies are about 40 per cent. for the transformer system and only 25 per cent. for the Graetz system.—*Archiv. f. Elek.*, Vol. 3, No. 1, 1914.



Two Methods of Connecting Up Electrolytic Rectifier.

HOW TO MAKE IT



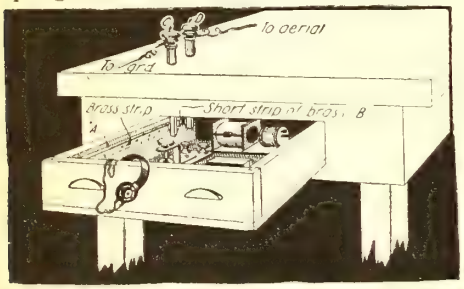
This department will award the following monthly prizes: FIRST PRIZE, $3.00; SECOND PRIZE, $2.00; THIRD PRIZE, $1.00.
The idea of this department is to accomplish new things with old apparatus or old material, and for the most useful, practical and original idea submitted to the Editors of this department, a monthly series of prizes will be awarded. For the best ideas submitted a prize of $3.00 will be given; for the second best idea a $2.00 prize, and for the third best a prize of $1.00. The article need not be very elaborate, and rough sketches are sufficient. We will make the mechanical drawings.

FIRST PRIZE $3.00.

RADIO SET IN TABLE DRAWER.

The diagram represents a scheme which I have worked up and would like to contribute to the "How to Make It Department." As I wanted my receiving set near at hand and yet ordinarily hidden from sight and protected from dust, I hit upon the following plan:

I took out my top bureau drawer, and after cleaning and sandpapering I gave it a couple of coats of black shellac. I then fastened my various instruments to the bottom in the most convenient way. Along the inner top edge on one side of the drawer I fastened a thin strip of copper "A" on a ⅛-inch piece of pine as shown in the diagram. This was separated about ½ inch from the aerial plate "B," also fastened on side of drawer as shown. Two binding posts "C" and "D" were screwed through the top of the bureau, as close to the inside of the drawer as convenient. On the under side of these binding posts (which were parallel to the side of the bureau) two copper strip brushes were fastened and bent so that they would brush against the strip on the side. The different instruments I connected up as usual. When the drawer was now closed the aerial was automatically *grounded*, and when the drawer was pulled out as far as possible the aerial was connected to apparatus ready for use. In one corner of the drawer I arranged a large twine spool with an old alarm clock spring. On this I wound my receiver cord



Mounting Radio Set in Drawer Makes It Dust and Fool-Proof, Besides Being Quickly Connected.

so that it would be wound up normally. In this way it takes me only a second to get my set ready for use, although it is not exposed to dust or to my younger brother's fingers.

Contributed by F. J. BACHMANN.

POINTERS ON STORAGE BATTERIES.

The following are some miscellaneous pointers on storage batteries:

Restoring weakened cells. There are several methods of restoring cells that have become low.

1. Overcharge the whole battery until the low cells are brought up to the proper point. 2. Cut the low cells out of the circuit during one or two discharges and in again during charge. 3. Give the defective cells an individual charge.

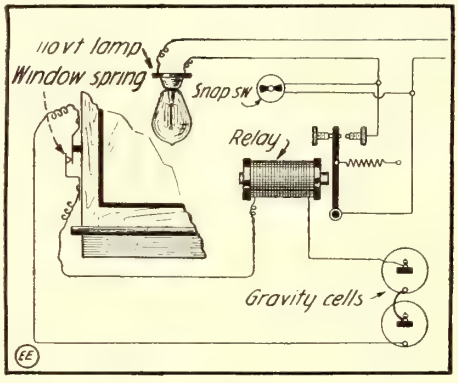
Idle batteries. If a battery is to be idle for, say, six months or more, it is usually best to withdraw the electrolyte as follows: After giving a complete charge, siphon or pump the electrolyte into convenient receptacles, preferably carboys, that have never been used for any other kinds of acid, and that have been thoroughly cleaned. As each cell is emptied, *immediately* refill it with water. When all the cells are filled, begin discharging and continue until the voltage falls to or below 1 volt per cell at normal load, and then draw off the water.

Contributed by EDW. CONNELLY.

SECOND PRIZE $2.00.

BURGLAR ALARM THAT TURNS ON LIGHTS.

A very reliable, closed circuit burglar alarm may be made from the following articles: Two or three gravity cells for battery, some closed circuit door and window springs, some double cotton covered wire, an old telegraph relay and some regular electric light wire. The relay and gravity cells and contact springs are set up in the usual way, for an ordinary closed circuit system, but instead of using dry cells and electric bells in the local circuit two wires are run from the lighting switch wires in such a manner as to connect the relay in parallel with the snap switch. The system works like this: Before going to bed as many lights as desired are left on and then turned off by the regular snap switch. If during the night an intruder should raise one of the windows or open a door, or even cut the wires, the circuit would be broken and this would allow the magnets to release the relay armature. Of course, as soon as the armature was released a contact would be made and the lamps would light up; current finding its way to the lights through the relay instead of through the snap switch. As everyone knows, a burglar is afraid of light and consequently he would be scared away before he even got into the house.



Scheme for Burglar Alarm Relay to Turn on Lights.

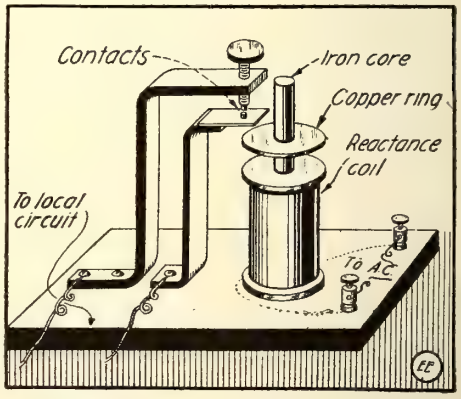
Contributed by GEORGE M. GILBERT.

THIRD PRIZE $1.00.

A NOVEL A.C. RELAY.

This relay can be constructed by anyone wanting a relay for handling heavy currents. First a core of transformer iron is procured. This should measure ½x½x6 inches. Around the core is wrapped two or three layers of friction tape. Then wind 135 turns of No. 11 D.C.C. over this. Wind a layer of tape around this and then a piece of empire cloth. Cover the cloth with shellac after it is on so that it has a smooth surface. Next procure a piece of about No. 20 B. & S. gauge copper sheet. From this is cut a circle 4 inches in diameter with a hole 1 inch in diameter in the center. Two supports are required for the contacts. These comprise two pieces of brass strip, one 9 inches and one 8 inches long, tapped 8/32 at each end. A bend is made at the top of the 9-inch support as shown, and a set screw with a silver contact placed on the end of it. To the 8-inch support a piece of spring brass with another silver contact is secured. These supports extend above the copper ring which is placed over the end of the reactance core. Now place the coil on its end, and firmly mount it. Next place the copper ring over the core. When the current is turned on, the copper ring jumps up and closes the contacts

Contributed by ROBERT CHANDLER.



An Alternating Current Relay. The Copper Ring is Repelled Upward, Closing the Contacts.

WAVES OF LIGHT AND ELECTRICITY.

There is a close similarity between light waves and the Hertzian waves employed in wireless telegraphy. The latter are subject to reflection and refraction, like light. Electrical waves will pass through many substances quite easily, while they are stopped by a sheet of metal. In a similar manner some materials are transparent to light waves, while others are opaque. It is now generally admitted by scientists that all forms of radiant energy—heat, light, Hertzian waves, etc.—are essentially the same, being of an electro-magnetic nature.

AN AUTOMATIC BATTERY CHARGING PANEL.

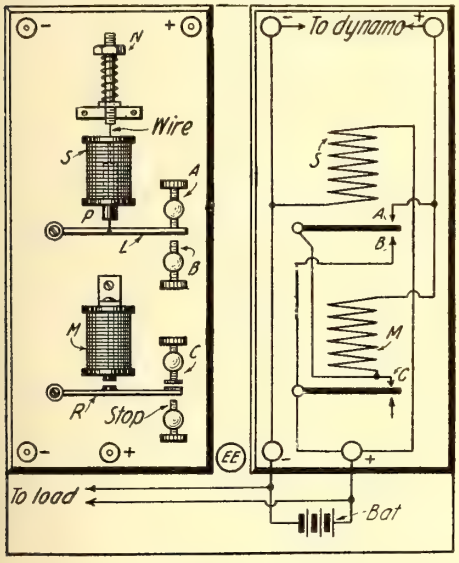
This is a simple device that will automatically switch on and off the charging current for storage batteries.

When batteries are discharged the drop in voltage will cause the soft-iron plunger P and lever L to drop away from the solenoid S, which is shunted across the terminals of the battery. Upon touching contact B the lever L closes the circuit for the charging current, which flows through magnet M, attracting armature R and closing the heavy copper contacts at C. These heavy contacts at C are to take care of any arcing that might occur should the charging current be broken by the smaller contacts at B.

When the battery is fully charged the effect of the rise in voltage will draw the plunger up into the solenoid S until lever L touches contact A; this short-circuits magnet M, causing the armature R to drop and open the charging circuit.

Solenoid S is wound with fine wire to the resistance of 120 ohms (one pound of No. 28 S. C. C. wire) for a 6-volt battery. Magnet M is wound with No. 16 S. C. C. wire (three layers).

After the battery is fully charged the first time the device must be adjusted by



Automatic Battery Charging Cut-Out.

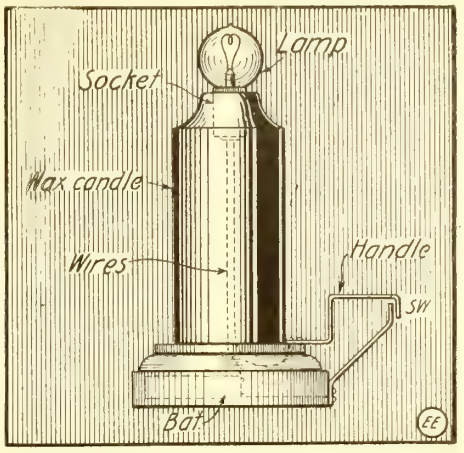
regulating nut N, which controls the pressure of the spring directly under it, and contact A. In like manner adjustments of contacts B and C are necessary when battery is in discharged condition.

If the load on the storage battery consists of any apparatus, such as lamps, etc., that cannot stand the gassing voltage of the battery (which is about 2.5 volts per cell) the idle contact marked "Stop" can be used to open the circuit marked "To Load" while battery is being charged. Contributed by ALBERT F. MURRAY.

A CHEAP ELECTRIC CANDLE.

An interesting and novel manner of transforming an ordinary wax candle into an electric one deserves consideration. It will prove invaluable in dark rooms and at night, where others grope around in darkness. It may also prove surprising that candles (though more elaborate) such as described here are retailed at prices ranging from $3 to $4.

A wax candle is first procured. At the top of the candle bore a small hole with a penknife, leaving a hollow opening into which the electric socket is later to be placed. The wick is pulled out entirely. This process leaves a hollow and empty center, into which the wires are run. The socket is slipped in at the top and wires are



Cheaply Made Electric Candle.

inserted through the center space where the wick formerly was.

Next obtain a hollow base of wood, which may be of circular shape. In the center of this base is drilled a small hole to admit the wires from the socket to be connected up to battery. A flashlight battery is necessary and the two wires are soldered to same, one to carbon, the other to zinc. A suitable handle is fastened to the base, wherewith the candle may be easily held in the hand. If desired the electric current may be controlled by a switch conveniently located, or the electricity supplied by the battery can be cut off by simply unscrewing the electric lamps in socket.

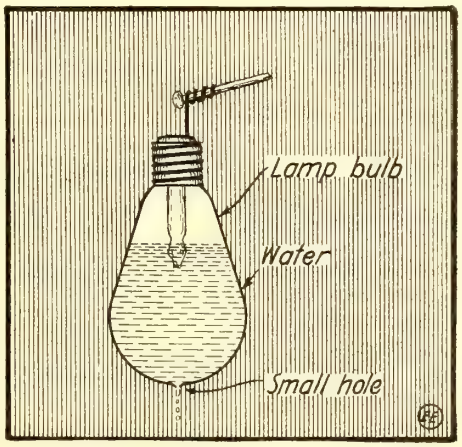
Contributed by WM. WARNHAM.

AN ELECTRIC BULB BAROMETER.

It is an easy matter to convert a burned-out, incandescent light bulb into a barometer that will foretell changes in the weather with remarkable success.

Place a discarded bulb under water in a deep basin, and after protecting the hands against danger from broken glass, break off the pointed bit of glass at the very end of the bulb with a pair of pliers. As soon as an opening is made in the glass the bulb will fill with water, which rushes in to take the place of the vacuum.

Tie a cord or stout string about the neck of the bulb and hang it on a hook or nail.



Barometer Constructed from Electric Lamp Bulb.

If the weather is to be fine, no water will drop from the hole at the bottom of the bulb. When the water begins to bulge out of the opening until drops fall from the bulb, you may expect a change in the weather.

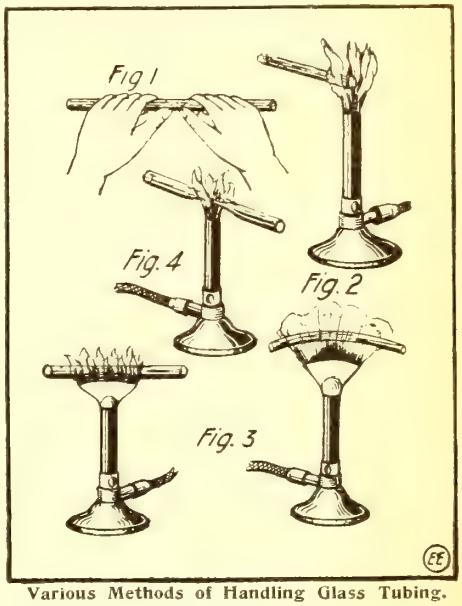
Atmospheric pressure governs the action of this simple barometer. When the pressure increases—a sign of fair weather—it pushes the water back from the mouth of the bulb, and no drop can form; when it falls, the water expands through the opening, until a few drops fall. As lower pressure nearly always precedes a change of weather, a drip from the bulb usually indicates a coming storm.

HOW TO HANDLE GLASS TUBING.

To break small glass tubes simply make a small file scratch on one side and then grasp the tube on each side of the scratch, placing the thumb nails together opposite the scratch and pull back. By using this method the tube will break evenly. (Fig. 1.)

Never leave the rough edges on the ends of the glass tubes, as it is dangerous and may result in cuts on the fingers. To round off the edges place in a gas flame (as from a bunsen burner) and allow the tube to remain until it becomes red hot, when surface tension will round off the edges. (Fig. 2.)

When bending glass tubing it is best to use a "fish-tail" burner, a burner giving a long flattish flame. When this kind of a burner is utilized the bend will be round



Various Methods of Handling Glass Tubing.

rather than angular and hence will be better, as angular bends are more likely to break, besides obstructing the flow of a liquid. Place the tube in the flame and turn it slowly, so as to distribute the heat uniformly. When the glass begins to redden stop turning and hold the tube by one end only. Leave the tube in the flame until it bends to the right angle. Always let gravity do the bending, as it is much more uniform and steady than bending by hand. Care should be taken to have the two sections in the same plane. (Fig. 3.)

Glass tubes can be closed by heating the end until it is very hot and then keeping it in a molten state for some time. The surface tension will gradually decrease the hole until it finally closes. Tubes can also be closed by pulling them apart. They should be heated to a cherry red color and then pulled gently on each end until they separate. (Fig. 4.)

In heating all glass care should be taken that it is perfectly dry, as any moisture is liable to crack it. Always heat gradually at first, and also let it cool gradually. Never try to heat real thick glass because, glass being a poor conductor of heat, it expands unevenly and is likely to break.

Contributed by KENNETH SUTTON.

Hearing Through Your Teeth

By H. Gernsback

THE following interesting experiment can be performed by anyone who has an ordinary disc phonograph. It is interesting, in so far as it shows the transmission of sound through the teeth, and through the bony substance of the human skull, which in turn reacts upon the auditory nerve. It is not well known but it is a fact nevertheless that sounds do not necessarily have to enter through the oral opening in order that we can hear sounds. Physicians in testing for hearing sometimes use a tuning fork which, after struck, is pressed with its lower part against the back of the skull, right behind the ear. The sound is then heard inside of the head the same as if it had actually entered through the opening of the ear itself. This principle is made use of in the experiment described here, and while it is not electrical by any means, it probably will interest every experimenter who owns a phonograph.

Stop up both of your ears with cotton as tightly as possible so that no sound will be heard from the outside. Now place an ordinary darning needle between your teeth by biting on it hard, taking care at the same time that the lips or tongue do not touch the needle. The latter is important because if either lips or tongue touch the needle the sound will be decreased considerably. For best results the needle itself should project not more than 1 or 1½ inch from the mouth. For that reason the darning needle should be broken off about one and one-half inches from its sharp point. It goes without saying that the sharp point should project out of the mouth while the broken off end should be inside of the mouth.



Using the Head as a Reproducer on a Phonograph.

Now start an ordinary disc phonograph and carefully press down upon the record with the needle's point held at the same angle as the reproducer's needle is held ordinarily. With a little practise one will become proficient in moving the head at the same ratio of speed as the ordinary reproducer arm is moved from the outside of the record towards the inside. As soon as the needle touches the record with sufficient pressure, the inside of the head will be filled immediately with music exceedingly loud and clear.

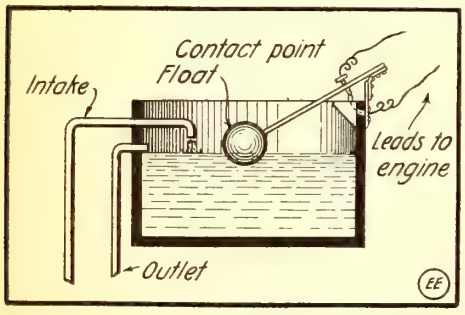
A curious result of the experiment is that a person standing near by can bear the music, the head acting as a reproducer in this case.

Of course, it will be understood that a totally deaf person will not be able to hear any sound if the auditory nerve is dead or inactive. It is, however, interesting to note that *partly* deaf people can hear the music quite well. This is particularly true of persons hard of hearing who cannot ordinarily hear the sounds of a phonograph.

The writer should like to hear from readers, particularly from those who are partly deaf, who have tried this experiment; *The Electrical Experimenter* will be glad to publish the results in subsequent issues.

AUTOMATIC STOP FOR PUMPING STATIONS.

The following is a suggestion to those who have pumping stations using gasoline or oil engines to pump the water into a tank. A great deal may be understood from the cut, but a little explanation may



Pumping Engine Cut-Off Switch Equipped With Float.

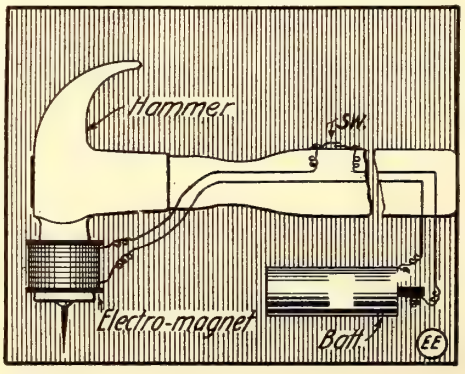
be necessary. On the side of the tank, just above the level of the outlet, is placed a triangular block of wood to which is fastened a contact point of suitable size, with a wire leading to the outside, and just above this is placed a shaft, which is hinged to the side of the tank and has a float at the end of it. A contact point on the end of an adjusting screw is put through the shaft vertically and is connected to another wire leading to the outside. The adjusting screw is put so that when the water is down it will rest on the other contact, and when the water rises to the overflow outlet the shaft rises and breaks the contact. The wire leads go to the engine (the negative one may be grounded to the water pipe if desired) and are connected in series with the batteries or magneto.

As soon as the water rises and fills the tank the contact is broken; the ignition current ceases to go to the engine and it stops, thus saving the waste of water and gasoline and making it unnecessary for anyone to keep watch over it.

Contributed by W. F. ALLSTON.

ELECTRO-MAGNETIC HAMMER.

Obtain a hammer, and if the end or tip of the hammer head is rusty, clean off the rust by using a piece of emery paper. Wind on five or six layers of No. 18 magnet wire. Leave leads on the magnet for about 6 inches. Take a small piece of brass (from a small flashlight battery) and bend as shown in diagram for a switch. With some small staples tack the wire firmly on the hammer handle and connect with the switch. Bring the wires to the end of the handle and tack them down firmly, leaving a few inches to connect with some flexible cord. A connector should be placed in the circuit, so that when the batteries are not



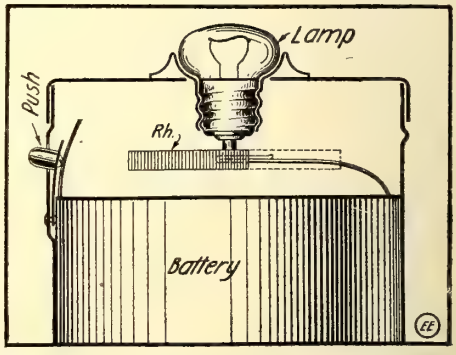
An Electro-Magnetic Hammer Proves Useful in Handling Small Nails, Tacks, Etc.

needed the cord will not be in the way. This hammer will work on three or four batteries nicely. Contributed by

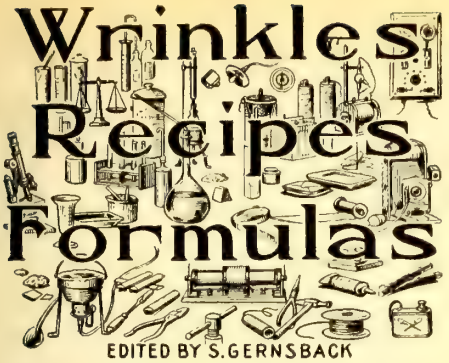
WALTER BRAHANEY.

GERMAN FLASHLIGHT HAS RHEOSTAT.

A unique, adjustable type of pocket flashlight has been developed for use in the German army, and it is useful in giving different kinds of signals, etc. The flashlight is shown schematically in the drawing herewith. It does not differ in a general way from those with which we are familiar, but the lamp may be lighted with different degrees of brilliancy by the use of the adjustable resistance coil placed against the back of the lamp. This coil is made to slide back and forth on the brass connecting lug from the battery as perceived. This is also of service in compensating for the drop in voltage of the batteries if a lower than normal voltage lamp is employed. It is, of course, apparent that if such a below normal lamp is employed, that it would undoubtedly be burned out in short order by a fresh battery. Hence, some of the resistance may be cut in, in this event, and as the battery voltage falls, after it has been used awhile, some of the resistance may be cut out; thus keeping the voltage on the lamp approximately constart.



Miniature Rheostat Controls Current Supplied to Flash-Lamp Bulb.



EDITED BY S. GERNSBACK

Under this heading we will publish every month useful information in Mechanics, Electricity and Chemistry. We shall be pleased, of course, to have our readers send us any recipes, formulas, wrinkles, new ideas, etc., useful to the experimenter, which will be duly paid for, upon publication, if acceptable.

FORMULA NO. 17.
Composition of All Kinds.

1. *Flexible Insulating Mass.*—Forty parts of *Shellac;* 40 parts of dry, finely pulverized *Asbestos, Flax Cotton, Wood* or *Paper;* 25 parts of *Wood Tar;* 1¼ part of *Paraffine.* Mix together in a vessel at 100 to 200 degs. F.

2. *Gutta Percha Composition.*—Six parts of *Gutta Percha;* 2 parts of *Bone Dust;* 1 part of *Pipe Clay.*

3. *Insulating Compound.*—One part of Stockholm *Tar;* 1 part *Resin;* 3 parts of *Gutta Percha.*

4. *Composition for Mouldings, Frames, Etc.*—Twelve parts of *Whiting;* 6 parts of fine sifted *Sawdust;* 1½ parts of *Linseed Oil Cake.* Knead this mass to a paste with a strong solution of glue.

5. *Another.*—Eight parts of *Pulverized Litharge;* 16 parts of *White Lead;* 2 parts of fine *Sawdust;* 20 parts of *Plaster of Paris.* Stir these ingredients into 26 parts of glue dissolved in sufficient water.

S. G.

POISON PREVENTER.

The following will be found a useful prevention from taking poison by accident: In the cork of the bottle insert some pins so that they extend above the cork slightly and are thus exposed. Cover the cork with these except a small space so that the fingers can hold the cork without being pricked. The idea is that when a person takes hold of the cork of this bottle in the dark they invariably will be pricked by the pins, which warns them that the bottle contains poison. Contributed by

ANDREW W. GALLAGHER.

A GOOD WRITING FLUID EASILY MADE.

A good writing fluid, of a rich, dark black, can be put up by following this formula:

Two and four-tenths grams of logwood extract, should be mixed with 100 cubic centimeters of distilled water. Heat should be applied until the substance is dissolved. After it is cooled potassium chromate should be added, until the desired shade is attained. From 2 to 3 c.c. is usually sufficient. A little gum arabic, or gelatine, may be dissolved in the matter to give it a good consistency, or "body."

If this method is followed the solution should then be filtered through silk. This finishes the fluid, and it is ready for use.

For Users of Fountain Pens.

I have always had great difficulty in unscrewing my fountain-pen for refilling. I found out, however, that if the threaded piece of the pen is slightly greased with a little vaseline the parts will unscrew much easier, and the contained ink cannot leak out, thus eliminating soiled fingers.

CHEMICAL BAROMETER AND FLASHLIGHT POWDER.

To make a chemical barometer take potassium nitrate, 30 grs.; ammonium chloride, 30 grs.; camphor, 120 grs.; alcohol, 2 ozs. Put the mixture in a bottle ten inches long and ¾ inch in diameter. Cover the bottle with a piece of perforated plaster. If fine weather is indicated the insoluble matter will settle at the bottom of the bottle; previous to a change for rain the compound gradually raises, the fluid remaining transparent. Twenty-four hours before a storm or very high wind the substance will be partly on the surface, the fluid being turbid and in a state resembling fermentation.

Flashlight powders: Take powdered magnesium, 3 ozs.; powdered chlorate of potash, 6 ozs.; powdered sulphide of antimony, 1 oz. Mix by sieving. One hundred grams to be used each time a photograph is taken.

Contributed by

RICHARD GAILLARD.

MAKING A HECTOGRAPH.

As the price of a good printing set is usually beyond the means of the average experimenter, the following device will not be found amiss as an excellent substitute:

First obtain a shallow tin dish (the cover of a bread box will answer the purpose well), an ounce bottle, an ounce of gelatine, 1 ounce of brown Demerara sugar, 6 ounces of glycerine and 2½ ounces of barium sulphate. Break the gelatine into small pieces and place in a sauce-pan with 3 ounces of water and let this steep overnight. Next pour in the glycerine and heat over a fire. Put in the sugar and let it heat until dissolved. Then take the barium sulphate and mix with 1 ounce of water in a separate cup. Pour this into the sauce-pan, and when thoroughly mixed pour it into the flat tin dish (which should be well cleaned) and then allow the mass to harden.

Buy some hectograph ink, or make it at home by filling an ounce bottle with 2 drachms of methyl-violet aniline and 2 drachms of spirit and dissolve it in 1 ounce of water. Write on a piece of paper whatever you want to reproduce, and place the paper, face downward, on the rubber-like surface, rubbing same gently on the written matter. After one-half to one minute, pull the paper off. Then take another paper and press upon the hectograph, and it will be reproduced as many times as you repeat this operation.

To clean the hectograph wash it first with water, mixed with an eighth part of hydrochloric acid, also known as spirit of salt; then clean the surface with pure water. Let it stand for 12 hours before using again. Contributed by

H. J. GUTHRIE.

A Bright Polisher.

A few grains of butter of antimony added to a bottle of ordinary machine-oil proves to be an excellent polisher for old furniture. It is easily made and brightens wherever applied to.

Contributed by W. W. J.

To Clean Brass.—An economical method of cleaning brass is to rub it with a mixture of *Vinegar* and *Salt,* or *Oxalic Acid,* then wash with *Water* and polish with *Tripoli* and *Sweet Oil.*

Another liquid polish for metal is as follows: *Jewelers' Red,* 25 parts; *Oil of Turpentine,* 15 parts; *Oil of Stearine,* 25 parts; *Animal Charcoal,* 45 parts; *Alcohol* sufficient to make the mass practically liquid. Apply with a brush. After the alcohol has evaporated rub with a cloth.

HOW TO PUT A PIANO FINISH ON WOOD.

If the wireless man wishes to finish his instruments or table with a finish which will not only last indefinitely, but closely rival the finish on his piano, the following process must be closely adhered to. The method described below is that which the manufacturers of fine pianos use.

1. Sandpaper the wood thoroughly with fine sandpaper. Do not sandpaper across the grain.

2. Use oil stain or dye. Put on heavy and wipe off surplus.

3. Next put on a good wood filler. Rub filler into the wood with excelsior. The pores of the wood should all be filled. Rub across the grain.

4. Sandpaper very lightly.

5. Give three coats of shellac. Thin white shellac is preferable. Sandpaper each coat when the shellac is dry before applying the next coat.

6. After the last coat of shellac is sandpapered apply a coat of the very best grade of varnish obtainable. Sandpaper this coat when dry.

7. Apply another coat of varnish. When *thoroughly dry* rub with *coarse* pumice stone. The pumice stone is put on *wet felt* and rubbed hard until the wood is entirely free from lumps and perfectly smooth. Wipe off all traces of the pumice stone with a wet rag or chamois skin.

8. Give the last coat of varnish.

9. Rub with *fine* pumice stone in the same manner as with the coarse, but do not rub as hard or as long. Rub just hard enough to take off any lumps which the varnish might have left. Wipe off any of the pumice stone remaining.

10. Rub with rotten stone in the same manner; that is, very lightly. Rotten stone is sold in small cakes about the size of your fist and is likewise applied with wet felt. Wipe the wood clean and let it dry.

11. Now rub with the palm of your hand. Rub hard until the wood is clear and smooth. You will now have a mirror-like finish. The wood becomes slippery after the hand rubbing and will not catch the dust.

In applying the varnish and shellac put on a thick coat roughly. Then use long sweeping strokes with a fine brush. Always wait until the varnish is dry before sandpapering. See that the varnish is always thin and plastic before applying.

Contributed by CARL A. HENLEIN.

RECIPES FOR JEWELERS' ENAMELS.

Melt together the combinations of materials as given below to make the various colors of enamel. Portions by weight.

Transparent Red—Cassius gold purple, 65 parts; crystal glass, 30 parts; borax, 4 parts.

Transparent Blue—Crystal glass, 34 parts; borax, 6 parts; cobalt oxide, 4 parts.

Dark Blue—Crystal glass, 30 parts; borax, 6 parts; cobalt oxide, 4 parts; bone black, 4 parts; arsenic acid, 2 parts.

Transparent Green—Crystal glass, 80 parts; cupric oxide, 4 parts; borax, 4 parts.

Dark Green—Crystal glass, 30 parts; borax, 8 parts; cupric oxide, 4 parts; bone black, 4 parts; arsenic acid, 2 parts.

Black—Crystal glass, 30 parts; borax, 8 parts; cupric oxide, 4 parts; ferric oxide, 3 parts; cobalt oxide, 4 parts; manganic oxide, 4 parts.

White, 1—Crystal glass, 30 parts; stannic oxide, 6 parts; borax, 6 parts; arsenic acid, 2 parts.

White, 2—Crystal glass, 30 parts; sodium antimonate, 10 parts. The glass used for this one must be free from lead.

Contributed by JOHN McCAFFERY.

WITH THE AMATEURS

Our Amateur Radio Station Contest is open to all readers, whether subscribers or not. The photos are judged for best arrangement and efficiency of the apparatus. To increase the interest of this department we make it a rule not to publish photos of stations unaccompanied by that of the owner. Dark photos preferred to light toned ones. We pay each month $3.00 prize for the best photo. Make your description brief. Address the Editor.

AMATEUR RADIO STATION CONTEST.
Monthly Prize, $3.00.

This month's prize winner.

E. JACOBSEN'S LABORATORY.

During my spare time I do considerable experimental work and am sending you some photos of my laboratory. I haven't any good photos at hand at the present time, so I am sending you just what I have available. I am going to high school at present and don't find much time for taking and finishing photos.

The views herewith show part of my photographic and chemical laboratory, also a flashlight of my "high tension" apparatus When this photo was taken I cut down the



Above: Edwin Jacobsen in his Chemical "Lab." Below: Taking Sparks from His Tesla Coil.

length of the high frequency spark from 12 to 6 inches, so that I could get a better picture.

I am always interested in seeing pictures of other laboratories published in the *Electrical Experimenter*, so that is the reason I am sending you these. I would say that most of my "lab' is located in the attic and that accounts for the slant to these pictures.

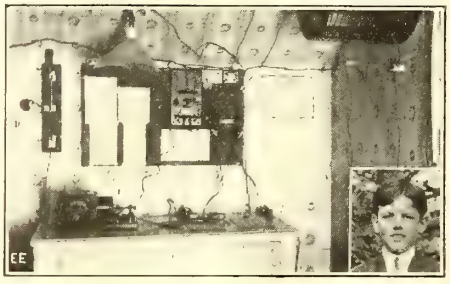
I will send you some illustrations of my wireless telephone and telegraph experimental sets in the near future.

EDWIN JACOBSEN.

Seattle, Wash.

RADIO SET OF B. W. DAVIS.

The accompanying photograph is of my wireless station. I will give a brief description of the station. Sending set: Thordarson 1 kw. transformer, home-made oscillation transformer, straight spark gap and 5-gallon bottle condenser, key and switches. Receiving set: 1,500-meter loose



Benton W. Davis and His Wireless Outfit.

coupler with hard rubber contact and switch point bases, hard rubber base galena detector and buzzer test, Electro Importing Co.'s loading coil and fixed condenser, Brandes' 2,000-ohm 'phones. I have 1 T. P. D. T. aerial switch and 1 S. P. D. T. lightning switch, also 1 D. P. S. T. switch for power circuit control. I also have radio maps of this city, Great Lakes, United States and the world. The aerial is 35 feet high, 65 feet long, with a one-wire 15-foot lead-in. It is composed of four strands of No. 14 Antenium wire, spaced 3 feet apart on 9-foot bamboo spreaders.

The local amateurs come in loud, and I also copy Arlington (NAA), Buffalo (WBL), Detroit (WDR), Ashtabula (WSA), Cleveland (WCX), Sarnis (VBE) and Point Burwell (VBF), Canada, besides many boat stations on the Great Lakes.

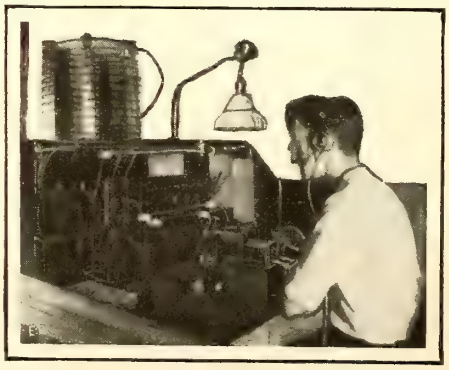
I have a Government operator's and station license, and my official call is 8QZ. I think your magazine is now the best of its kind in the field.

BENTON W. DAVIS.

Cleveland, Ohio.

RADIO STATION OF THOMAS R. HICKS.

I would like very much to see the accompanying picture of my station in *The Electrical Experimenter* radio station contest.



Thomas R. Hicks Gets All the Long Distance Stations.

My aerial is 70 feet high and 70 feet long and is composed of four cables, each consisting of seven strands of No. 22 B. & S. gauge copper wire. The ground is a No. 4 copper wire 40 feet long.

My receiving set contains a type A.A. Crystaloi detector, an inductive tuner, a 35-plate variable condenser, a home-made condenser and one set of Brandes' transatlantic 'phones. My sending outfit is composed of a 1-inch E. I. Co. Bulldog spark coil, E. I. Co. spark gap, aerial switch and electrolytic interrupter, a Brandes' heavy service key, a home-made helix and a high-tension condenser.

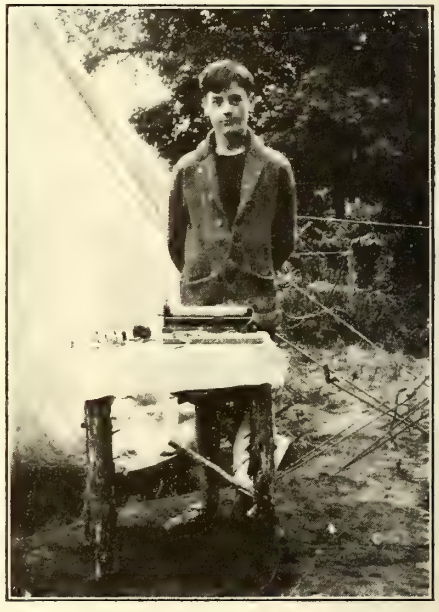
I get very good results with this set and can receive N.A.A., W.C.C. and N.A.R., besides all the amateur stations around West Chester.

THOMAS R. HICKS.

West Chester, Pa.

RADIO SET OF L. H. BUEHL.

The accompanying photgraph is of a wireless set I made in camp. I constructed



Louis H. Buehl Owns an Efficient Portable Radio Set.

it with a pair of pliers, a pair of scissors and a saw. The two-slide tuning coil was a rolling pin on which was wound bare copper wire with string as the insulating material. This was then shellacked. The end pieces and the base were made out of a soap box and the slider was made from a barrel hoop straightened out. The slider was a block of wood and a piece of tin; the condenser was also made of tin, with air as a dielectric, and last of all the detector was made from a safety pin and some mineral. I brought the 'phones, binding posts and minerals with me. The shellac was obtained at a near-by farm-house.

LOUIS H. BUEHL.

Philadelphia, Pa.

Electricity is man's most willing servant. It does all his tasks gladly, but, like a snake, will strike back when least expected.

EXPERIMENTAL STATION OF DAVE BORDWIN.

I present herewith photograph of my wireless station and myself, which I would like to see published in the monthly prize contest of your dandy magazine.

My aerial is 64 feet long, 38 feet high and is composed of four strands of No. 14 copper wire spaced 2 feet apart. The lead-in is of No. 4 wire run to a large 600-volt,



Compact and Serviceable Radio Station of Dave Bordwin.

100-ampere lighting switch. From there a No. 4 wire is run from the switch to a pipe driven 7 feet into the ground. The receiving set contains a large double-slide tuning coil, loading coil (next to tuner), fixed condenser and galena detector; these are all my own make. I also have one 1,000-ohm Brandes' receiver and an Electro leather-covered headband, which I like best, for it fits the head just right. A buzzer test is also used, which I can work from the table and also with my foot if desired. I shunt my detector while sending, so that I do not loose my "spot" on the galena and also do not then hear the noise in my receiver. The sending set has a 1-inch spark coil, Amco key, Electro spark gap and home-made glass-plate condenser. Both table and instruments are stained a light mahogany.

I hear Arlington very loud without using my loading coil. My receiving range is about 300 miles and sending range eight miles. I am very well satisfied with my station. I would be glad to hear from other amateurs. DAVE BORDWIN.

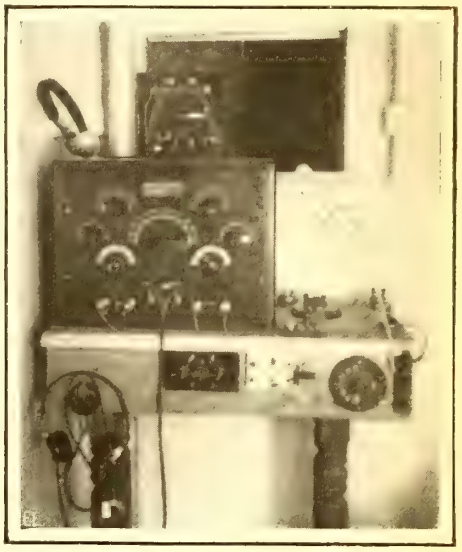
Paterson, N. J.

WIRELESS ON THE FARM.

Clement & Taylor, two Winthrop, Me., farmers, have a wireless telegraph installed on their farm. Mr. Clement, who was a telegraph operator before he was a farmer, has installed a receiving apparatus at their farm and they are thus able to get the standard time and the weather reports from Washington every day, learn the latest war news, and oftentimes catch messages sent out from boats at sea signaling in their location. He generally knows when the Boston boat gets in at night, and although the change from the Morse code to the Continental, used by the Government, bothered him a little at first, he is able to decipher most of the messages which his receiver is sensitive enough to take.

WIRELESS OUTFIT OF F. B. MEEKER.

Below is a picture of my wireless station, and the following comprises the apparatus which I am using: One type R. L. C. 3 special Mignon receiving cabinet, one E. I. Co. vario-selective cabinet set, one Perikon, one Gribe and one Electro detector; also one E. I. Co. loading coil, fixed variable and fixed condenser, a set of their 3,000-ohm 'phones and one set Navy type 2,000-ohm receivers. I have two aerials; the larger



F. B. Meeker's Modern Wireless Outfit.

one is 110 feet long and consists of two wires on 3-foot spreaders, and the smaller one is 50 feet long, with four wires on 6-foot spreaders. Both of these are supported on masts located on the roof.

New York City. F. B. MEEKER.

Amateur News

Radio Prizes Offered by Troy Amateurs.

The Amateur Marconi Radio Association, of Troy, N. Y., and vicinity, is planning an active fall and winter season. Extensive experiments with portable wireless receiving sets will be conducted and prizes will be awarded to members transmitting messages the greatest distance. The association has a large membership and practically everyone of its members has his own wireless plant. The association, however, is desirous of increasing its membership so its work can be carried on along broader lines, and the president, W. W. King, would like to hear from amateur wireless operators not already members. The association has its meetings in the North Troy Young Men's Christion Association building, and each of the meetings is addressed by experts. Malcolm Williams, of 1627 Seventh Ave., Troy, has been elected secretary in place of Harold Connor, who recently resigned. Communications relative to membership should be addressed to Secretary Williams.

Radio Club of Hartford News.

About 50 members of the Radio Club of Hartford, Conn., gathered at the State armory recently for the purpose of inspecting the new wireless apparatus received by the National Guard. After the apparatus had been thoroughly looked over in the squad drill room, it was carried out to the armory lawn and set up there and the members of the club picked up many messages from the sky. At the conclusion of this test the members gathered in the company room of the signal company and listened to Captain George E. Cole, who told them the nature of the service in the National Guard, its good points and bad. As a result it is expected that a signal section of 20 members of the club, all more or less acquainted with the art of wireless signaling, will soon be enlisted and put in service.

Western Students to Have Radio Club.

The students of Western High School, at Bay City, Mich., are working on a wireless station which will be in receiving range of all high power stations on the coast. The aerial was constructed and put up last June and the students are now working on a condenser, oscillation transformer and rotary spark-gap. Mr. Crawford, one of the instructors, is in charge of the work.

The object of the station is not to make wireless telegraphy a part of the course of study, but to organize a club of enthusiasts. One meeting has been held by the students who expect to join the club, and it is expected that in the course of one or two more meetings the organization will be perfected.

Wireless for Boy Scouts.

At a meeting of the Boy Scouts of Orange, Texas, of which Stanley Barnes is the scoutmaster, a movement was started for the establishment of a wireless telegraph station at that place. The boys will seek the assistance of citizens. They believe that it will come in for good service in the event that the telegraph and telephone wires should cease to work, as they did during a recent storm.

Radio Apparatus for Hartford, Conn., Y. M C. A.

The educational department of the Y. M. C. A., of Hartford, Conn., has bought a complete wireless telegraph receiving set, and is having erected on the top of its new seven-story building a large aerial for the use of a class of boys. This class will have for its object both instruction in the use of the wireless apparatus and its construction, and also the principles of electricity. The class will be taught by Clarence Tuska, who is already well-known in wireless circles as the secretary of the Radio Relay League, which has stretched across the continent within the last few years. He is also well-known in Hartford because of his ability in the use and construction of wireless apparatus. Without doubt this class will prove to be the most popular of the new boys' courses which the Hillyer Institute is putting in its curriculum this year.

RADIO CLUBS ATTENTION!

We are always pleased to hear from young Edisons and Radio Clubs. Send a write-up of your Club with photos of members and apparatus to-day to: Editor "Amateur Gossip" Section, The Electrical Experimenter, 233 Fulton St., New York City.

RADIO LEAGUE OF AMERICA.

(*Continued from page 491.*)

ciated by every radio amateur in the United States:

NEW YORK, November 27, 1915.

Editor of ELECTRICAL EXPERIMENTER, 233 Fulton Street, City:

DEAR SIR: Thank you for your favor of November 22.

I fully realize that the Radio League of America may accomplish much good in the development of the art, particularly in bringing influence to bear on Congress in the interests of new legislation regarding regulation of wave lengths and interference.

The Institute of Radio Engineers is now seriously considering a propaganda for bringing about new legislation, which will probably be in the form of permitting more or less individual freedom of wave length within certain restricted zones. For example, the amateur should have individual freedom within a certain zone of short wave length, commercial vessels should have two zones, one for smaller vessels and one for the larger ones, equipped with high power apparatus. The Government should have two or three zones, and the commercial shore stations also should have one or two zones of wave lengths allotted to them.

If such a proposition as this is carefully looked into and energetically brought to the attention of Congress, I believe much good will result.

I have no doubt that most of the members of the Radio League will enthusiastically champion such an effort, if it is properly put before them.

I would suggest that when the time comes you would consult with the authorities in the Institute of Radio Engineers, so that all may co-operate and work together towards a common end.

Wishing the Radio League of America every success, I am, Yours very truly,

LEE DE FOREST.

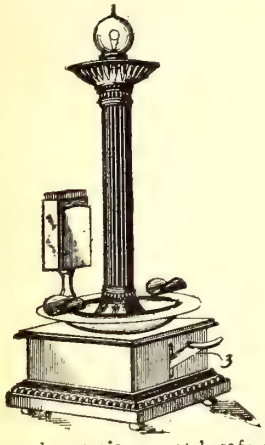
Do not fail to read the big announcement of the *Radio League of America* in the December issue.

LATEST PATENTS

Electric Waiter-Signal.

(No. 1,149,933; issued to Antoine Martzolf.)

A novel device, which embodies a miniature electric lamp and pedestal



which also carries a match safe and ash tray. One purpose of this device is stated to be that of lighting up the match holder and the second distinct purpose called for in the use of this arrangement is in restaurants, so that by pressing the switch lever 3, on the side of the pedestal base, the patron can silently engage the attention of the waiter without annoying other guests. A miniature battery lamp is used in this device, together with a regular flashlight battery of small size contained in the base of the pedestal.

Take-Up for Flexible Conductors.

(No. 1,153,829; issued to Ernest F. Rueckert.)

A useful device in the form of a

Fig. 1.

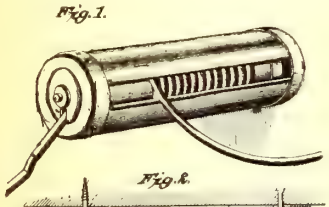
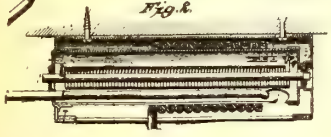


Fig. 2.

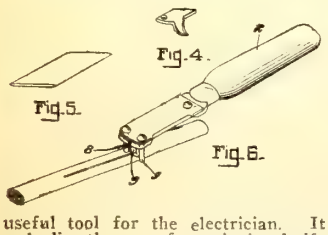


spring actuated drum and shield over the outside of same for automatically taking up or letting out flexible cord such as used for electric lamps or heating devices, etc. The drum is arranged so that by a slight pressure it will be released and as much cord as required may then be drawn out from the slot in the outer shield.

Tool for Stripping Wire Insulation.

(No. 1,153, 286; issued to Henry D. Cahill.)

This device for stripping insulation from electric wires should be a very



useful tool for the electrician. It embodies the use of a stripping knife 8 and two guide pins 8 and 9. These are suitably supported on the handle 2 and when the device is drawn along the insulated conductor, such as duplex cable for instance, the braid covering is easily slit open. As observed this tool is much more accurate and satisfactory than a common penknife for the purpose, unless the latter is wielded by a skilled mechanic.

Multiple Detector Scheme for Radio Receptors.

(No. 1,155,653; issued to Edwin R. Gill.)

A scheme utilizing the principle of successively switching into circuit, a number of coherers in the radio receiving circuit proper, and which may be successively hooked up in a common circuit in series or in parallel with respect to themselves. A motor or other device 16, is utilized to constantly rotate a wheel and axle

Fig. 1

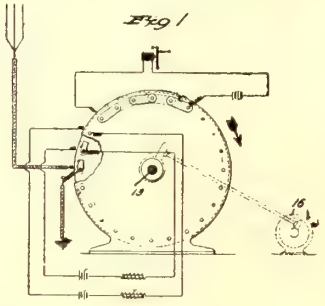
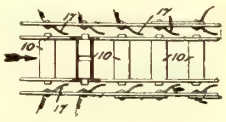


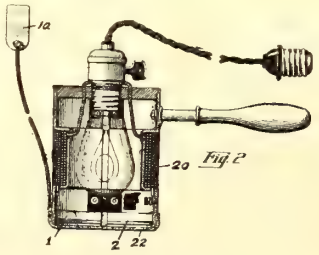
Fig. 2



13, and the coherers are mounted on the periphery of the wheel, as depicted at 10. Spring contact 17 closes the circuits of the various coherers as perceived. Several advantages are claimed for this arrangement including the operation of mechanical devices by means of a relay. Also steady operation is said to be obtainable owing to the constantly changing number of detectors, which are de-cohered in a separate electric circuit and revolved back into the radio receiving circuit proper again, etc. Several features which cannot be covered here for want of space are incorporated in this patent and it will pay those interested to procure a copy of same.

Thermo-Electric Treatment Apparatus.

(No. 1,154,144; issued to Alma M.



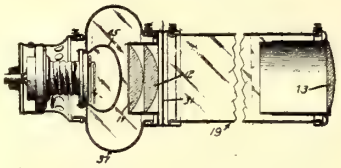
Wagoner, administratrix of the Estate of James B. Wagoner, deceased.)

The patentee of this device for electro-therapeutics has provided same with a pilot lamp as perceived, to indicate whenever current passes through the instrument. At the lower end there is stretched a fabric diaphragm 22 to be placed in contact with the patient's body. The electrode 10 is applied on another portion of the body. Surrounding the lamp are two semi-cylindrical plates 1 and 2. At the center there is wound a primary and secondary coil. When the apparatus is in use an induced current from the A. C. supply is produced in the secondary coil 20 and by means of a condenser action a mild current is thus caused to pass through the patient's body, from the electrode 10, through the nerves and muscles, to the semi-cylindrical plates 1 and 2.

Electric Advertising and Illuminating Lamp.

(No. 1,153,445; issued to Joseph T. Roffy.)

This idea covers an arrangement



for utilizing a single electric lamp 45, which projects a beam of light through the lenses 11 and 12 and advertising stencil at 31. This stencil has its image thus projected through the tube 19, and lens 13 onto the sidewalk in front the store, etc. Simultaneously the lamp 45 is here used by the inventor to provide general illumination through the special glass shade 37.

Combined Lamp and Telephone Cover.

(No. 1,153,507; issued to James McIntosh.)

This patent covers a special form of electric or other lamp as observed the pedestal of which is so formed as to readily contain an ordinary desk type telephone within it. This apparatus is accessible by simply

Fig. 1

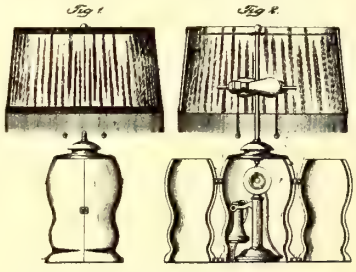


Fig. 2.

opening the double doors forming a part of the lamp pedestal.

A Watch Style Flashlight.

(No. 1,155,249; issued to Harry M. Koretzky.)

A much desired style of electric flashlight resembling the ordinary watch in size and appearance has been here developed. The drawing shows clearly how the inventor arranges the battery B, and also how the push button S is incorporated in the special stem 5. The tungsten lamp appears at 9 and the patent also

Fig. 1.

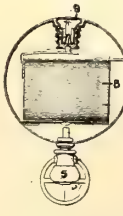


Fig. 2.



covers the arrangement of this lamp crosswise in the case.

Sound Intensifier and Reproducer.

(No. 1,153,431; issued to Clinton Horace Hulbert.)

A distinct and novel form of sound amplifier and reproducer adaptable to telephonic or radio purposes is here shown. It is provided with four permanent steel magnets, placed 90° apart, in a special sound insulated box, as drawing shows. Between the magnet poles are mounted two electro-magnet coils 22 and 23. A laminated iron core appears at 16. When a telephonic or other current passes through the coils, it causes a compound polarization action in the two magnetic diaphragms 31 and 32. These diaphragms are placed close together and form a gas-tight chamber between them, which chamber is joined to the rubber tube 33 and nozzles 34 and 35. Compressed air or gas may be used in the chamber formed between the two diaphragms and when these are pulled apart, by the electro-magnetic action due to currents in

Fig. 1

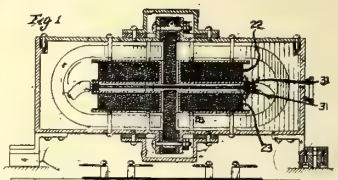
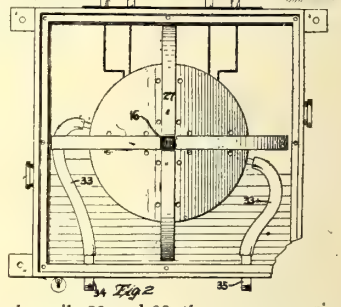


Fig. 2



the coils 22 and 23, they cause a variation in the gas pressure, which may be manifested at a gas tip, thus making possible the recording of a voice on a moving strip of film, photographically.

Flashlight Attachment for Pencils and Pens.

(No. 1,148,661; issued to Hunter Dennis.)

A unique flashlight attachment including miniature battery B, is contained in an insulated cap 25, attachable to the end of any ordinary pen or pencil. Connections are arranged to be carried in the device, down to



the miniature electric bulb 33, provided with a reflector 34. A timely invention which should prove of value to reporters, professional men and others, when properly commercialized.

A Cigar Style Flashlight.

(No. 1,153,420; issued to Alexander Brody.)

The inventor of this flashlight proposes to make same in the form of a cigar and also to finish the outside of it to resemble such. The usual battery and flashlight bulb are contained within the shell and instead of using an ordinary switch or push



button to light the lamp, he makes use of a split push 17, intended to be gripped between the teeth and in this way closing the circuit through the device. This leaves both hands free. Presumably the whole affair has been gotten up more as a novelty than anything else.

COPIES OF ANY OF THE ABOVE PATENTS SUPPLIED AT 10c. EACH.

Phoney Patents

Undef this heading are published electrical or mechanical ideas which our clever inventors, for reasons best known to themselves, have as yet not patented. We furthermore call attention to our celebrated Phoney Patent Offizz for the relief of all suffering daffy inventors in this country as well as for the entire universe.

We are revolutionizing the Patent business and OFFER YOU THREE DOLLARS ($3.00) FOR THE BEST PATENT. If you take your Phoney Patent to Washington, they charge you $20.00 for the initial fee and then you haven't a smell of the Patent yet. After they have allowed the Patent, you must pay another $20.00 as a final fee. That's $40.00 ! ! WE PAY YOU $3.00 and grant you a Phoney Patent in the bargain, so you save $43.00 ! ! When sending in your Phoney Patent application, be sure that it is as daffy as a lovesick bat. The daffier, the better. Simple sketches and a short description will help our staff of Phoney Patent examiners to issue a Phoney Patent on your invention in a jiffy.

PHONEY PATENT OFFIZZ

O. WHATAHED, CITY OF HADES

No. .01 ($.9\sqrt{6^n}$) **LAZY MAN'S DELIGHT** **Patent Applied for at Bedtime Regularly.**

To All Gents and Others.
Whoever It Concerns:

May it be known that I, O. Whatahed, of the City of Hades, State of Indolence, have at last, after many nightmares, rescued the poor married man from the bugaboo of laboring deep in the cellar while "She" rests comfortably in the arms of Morpheus. No longer does he have to get up at 5 o'clock in the morning to woo the furnace and "go six rounds" with the ash can, besides wasting matches and temper trying to get the furnace started. Now all he has to do to keep the house, feet and heart warm is to 'phone to the coal dealer and make out the check. The rest of the hard work around the household is taken care of by my apparatus, which has taken the lifetime of my father, his father and myself to perfect.

A can of opium and a glance at the specifications attached will clear away all fog as to how this wonderful apparatus operates. It may be attached to any common furnace by merely removing the ashes and coal that normally lay about and putting the apparatus in place. The operation of this device will be understood by all mechanical and electrical husbands skilled in the art of coalfurnacing.

The operation of this apparatus is entirely automatic. The solenoids A and C operate, when the pressure drops below a certain point, to feed more coal to the furnace O. The surplus steam drives a triple expansion cross-compounded engine operating the generator, which in turn charges the storage batteries I. These storage batteries are used for lighting the house and for sundry other purposes, such as dispelling the fog in the fire room and operating the various solenoids. The feed pump E is controlled by solenoid B, which is regulated from the well by the water level indicator and keeps the proper amount of water in the boiler and thus prevents explosions and also any disturbance of the owner's dreams. The solenoid D automatically turns on the engine when the charge in the batteries drops below a certain predetermined but unknown point.

By means of the switchboard mounted in the kitchen it is possible to keep tabs on the apparatus and control the "juice," which is so freely generated by this magnificent plant. The switchboard also has mounted on it the usual steam pressure indicating apparatus and a whistle.

This whistle may be put to several uses, among which may be noted that it will play *"I Didn't Raise My Boy to Be a Stoker,"* to call the family to breakfast and to hail passing mortals who are rolling heavily on account of undue cargo and who consist mostly of the flotsam and jetsam cast aside by the sea of Fate.

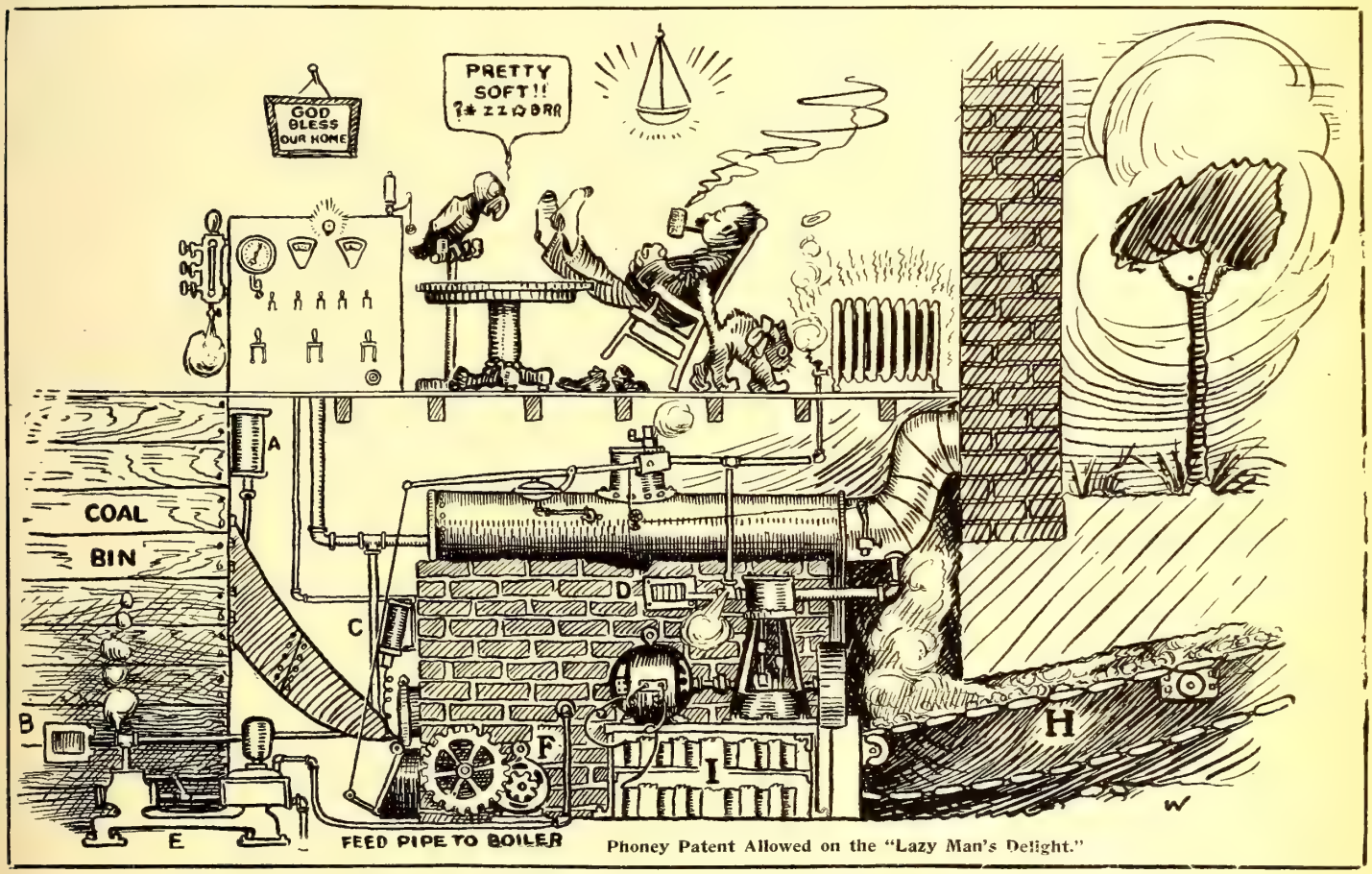
The main defect with furnaces and such allied appliances is that they provide no means for the removal of ashes, but I get away from this by having a traveling grate driven by the motor F and the conveyor H. These take care of the ashes from the furnace and remove them to regions unknown and unexplored by others than the employes of the Ash Removing Contractional Corporation.

At present the only thing that is lost with this apparatus is the "smoke" and the sound of the steam whistle; however, plans are being made to utilize both. Thus tobacco will be used as a fuel, and by running a pipe into the chimney I will be able to compress the smoke and supply it to the consumers in large quantities and thus put the ever-grasping Tobacco Trust out of business. This latter detail is of so much importance that I have applied for a separate Phoney Patent on same. Arrangements have also been made to sell the whistle's sound to the Phonograph Trust.

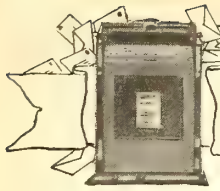
In testimony thereof, for or against, etc., ad infinitum, I hereto attach after heretotore disattaching one certain and specified seal (live, stuffed or coat) this night of horrors in the City of Hades.

Witnesses:
G. Wilikens,
O. Piffle,
I. Gotbit.

O. WHATAHED,
By his attorney,
Alvin L. Akers.



Phoney Patent Allowed on the "Lazy Man's Delight."



QUESTION BOX

This department is for the sole benefit of the electrical experimenter. Questions will be answered here for the benefit of all, but only matter of sufficient interest will be published. Rules under which questions will be answered:

1. Only three questions can be submitted to be answered.
2. Only one side of sheet to be written on; matter must be typewritten or else written in ink, no penciled matter considered.
3. Sketches, diagrams, etc., must be on separate sheets. Questions addressed to this department cannot be answered by mail.

Radio Engineers.

(395.) Frederick B. Stock desires to know the training necessary to become a radio engineer.

A. To become a first-class radio engineer, worthy of the name, it is necessary to have a complete knowledge of mathematics and more or less information on general electrical subjects. The best thing to do is to take a course in electrical engineering at some college or university, and after graduating from same to take post-graduate work of about two years in some school that teaches radio-telegraphy.

Radio Licenses.

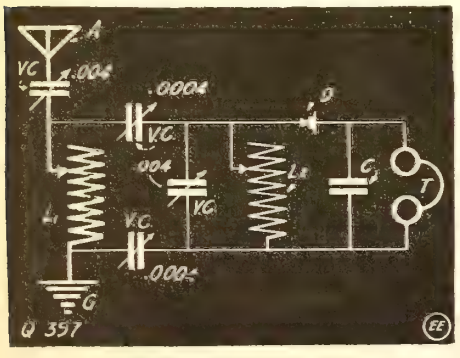
(396.) George E. Watt, Brooklyn, N. Y., requires information on the necessity of obtaining a license for wireless apparatus.

A. In answering this we can do no more than quote the law on this point, which states that no person, company or corporation shall use apparatus "for the transmission of radiograms or signals, the effect of which extends beyond the jurisdiction of the State or Territory in which the same are made, or where interference would be caused thereby, with the receipt of messages or signals from beyond the jurisdiction of the said State or Territory, except under and in accordance with a license, revocable for cause, in that behalf granted by the Secretary of Commerce and Labor upon application therefor." No license is required for receiving wireless messages.

Details of Dr. Cohen's New Set.

(397A.) T. C. Potts, Pittsburgh, Pa., writes us asking: 1. The size and amount of the wire used in the inductances in Dr. L. Cohen's receiving set. 2. Will this set be superior to a set composed of the standard instruments, loose coupler, etc.?

A. 1. The accompanying hook-up gives the size of the condensers used with the Cohen apparatus. The inductance coils, L_1 and L_2, for this set may be made on a tube 18 inches long by 6 inches in diameter, wound with No. 28 S. C. C. wire. This size will be sufficient for all-around amateur use, and you will be able to tune to wave



Dr. Cohen's Radio Receiving Hook-Up.

lengths in the neighborhood of 4,000 meters.

A. 2. This apparatus is vastly superior to the loose coupled tuners, as it takes up less space, is easier to adjust, and is, besides, more efficient and selective.

Step-down Transformer.

(397-B.) Joseph G. Reed, New Lambton, N. S. W., Australia, desires to know the dimensions of a step-down transformer for changing 240-volt, 50-cycle alternating current to 110-volt alternating current having a capacity of 1 K.W.

A. This transformer should be wound on a rectangular core having a cross-section of four sq. in. and forming a square 12 in. wide by 14 in. long. The primary should consist of 720 turns of No. 12 D. C. C. wire insulated from the core by four or five layers of Empire cloth. The secondary contains 330 turns of No. 10 D. C. C. wire and is also insulated from the core. This transformer can be connected direct to the 240-volt supply and will be self-regulating, have an over-all efficiency of about 80 per cent. if high-grade transformer iron is used in constructing the core.

Harnessing Gravitation.

(398.) George Abkemeier, Washington, Mo., writes us about an original scheme intended for use in driving a small 80-watt generator. He intends to use a drum on which a rope is wound, and a heavy weight is attached to the end of the rope. He intends to gear this arrangement up with a set of six pulleys, with a ratio of approximately 50,000 to 1. This is to be used to drive the machine at 2,000 r. p. m. and to run for four hours with the weight to drop only 60 feet. He wishes to know if this scheme is practical, and the weight to be used?

A. We would like to say that this scheme may be feasible, but the great loss entailed in so many gears reduces the efficiency of the apparatus. We have calculated the weight necessary, taking for granted that the rope is to be wound on a drum one foot in diameter and the efficiency of the arrangement 80 per cent.; when, as a matter of fact, it will hardly exceed 40 or 50 per cent. With the above arrangement it will require a weight of 18,000 pounds to drop 60 feet for four hours' run, or 15 feet an hour, to drive the dynamo up to full capacity. The only way to offset this tremendous amount of weight is to use a smaller weight arranged to drop through a greater distance.

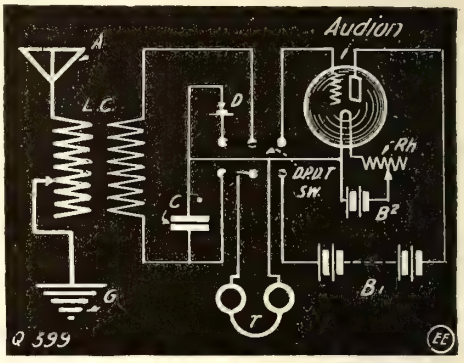
Hook-up for Detector and Audion.

(399.) James L. Autry, Jr., Houston, Tex., writes us asking: 1. How to connect an audion with a crystal detector so that either can be put into the circuit by means of a switch? 2. How to connect his 2,000 and 2,800 ohm head sets so they will give the loudest signals under all conditions? 3. How to use a Knapp type battery motor on a bell-ringing transformer?

A. 1. We give herewith illustration which will enable you to quickly switch from mineral detector to audion for receiving wireless messages. One D. P. D. T. switch is necessary for this purpose.

A. 2. The 'phones you mention are nearly of the same resistance, and you may connect them in series in accordance with the usual practice, and the results will be very satisfactory.

A. 3. You may operate the small battery



Audion or Mineral Detector Controlled by D. P. D. T. Switch.

motor from alternating current by two methods. One is to short-circuit the commutator by wrapping a few turns of bare copper wire around it and removing the brushes. The field is connected direct to the current supply, and the motor will operate as an induction motor. Another method of accomplishing this result is mentioned in the December issue of *The Electrical Experimenter* on page 422.

X-Ray Screens.

(400.) Gerry Davis, Union City, Pa., wishes to know what chemicals are employed in making a fluoroscope screen for X-ray work?

A. Several chemical preparations are used for this purpose, particularly sulphide of zinc, tungstate of calcium, platino-barium-cyanide. The latter is the one most used, giving excellent results, but is rather expensive.

The Sayville Station.

(401.) George Huss, Lakewood, N. J., desires to know: 1. The type of radio transmitter used at Sayville, L. I., and wave length of this station. 2. Whether Sayville has any regular schedule for transmission; and, if so, at what time? 3. The power of several other stations.

A. 1. The transmitter used at the Sayville station at the present time is of the well-known frequency changing type described several times in the past in *The Electrical Experimenter* and gives a high frequency current without the use of spark gaps. The wave length used by Sayville is, to the best of our knowledge, about 6,000 meters.

A. 2. Sayville starts to send "press" to ships at sea at about 9 o'clock in the evening and repeats the messages. The length of time the operator sends depends on the amount of business to be transacted. The station works at frequent periods during the day, depending, of course, upon the business on hand.

A. 3. We are not aware of the power used in the various stations mentioned in

(*Continued on page* 506.)

THE ELECTRO-SET CO. PRESENTS THIS PAGE FOR EXPERIMENTERS

Showing a few of the Extraordinary Values in their Catalogue and Listing Several Bargains in Used Parts and Apparatus that no Experimenter can afford to miss

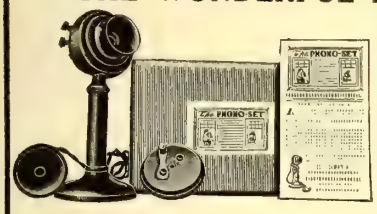
OUR FAMOUS 1-6 K. W. TRANSFORMER



Thousands of amateurs will welcome the advent of this instrument who either did not require ¼ K.W. power or who did not care to spend the money for it. The transformer will send messages for twenty miles—not a wild figure, but an actual fact — if a good aerial is used. **Under extraordinary circumstances it will send one hundred miles.** No trouble with vibrators and adjustments, reactances or resistances. **Just connect the primary terminals to 110 volt, 60 cycle A. C. mains and press key.** Best silicon transformer iron is used in its construction. The primary is wound with cotton covered, enameled wire, costing more but safer than single cotton. The secondary is built in sections each wrapped in empire cloth. Mica insulation is used where necessary. It will throw a heavy crashing spark that, with proper condenser, will fill a gap with a ball of white flame ¼ inch in diameter. This comparatively small but powerful spark will send **six times as far as a 1 inch spark coil.**

No. 1000 1-6 K.W. Closed Core Transformer, without case, shipping weight 10 lbs. **$6.95**

THE WONDERFUL PHONO-SET $1.00

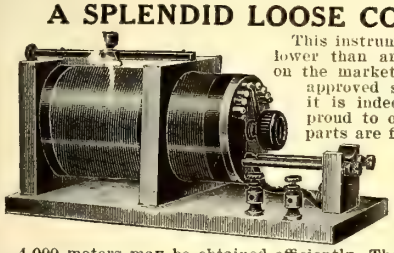


A handsome, perfect working miniature desk telephone, 7½ in. high. Talks for hundreds of feet (¼ mile) between any two points.

Outfit consists of regulation pattern desk 'phone with carbon grain transmitter, and a handsome little watch case telephone receiver with flexible cord for connections. A polished wood base switch is included FREE with each outfit. Handsomely finished in black enamel. Works on one 15-cent dry battery. Two outfits are required to talk both ways. One outfit talks one way. Full instructions included. A 10-year-old boy can connect and operate it. The first time an Electric Telephone ever was made at the price; only tremendous production makes it possible.

Price, postpaid **$1.00**

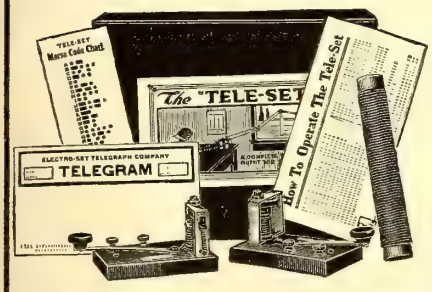
A SPLENDID LOOSE COUPLER AT $6.85



This instrument is priced at from 20 to 50% lower than any other instrument equaling it on the market. Made throughout in the most approved style and of the best materials, it is indeed an instrument which we are proud to offer to our customers. The wood parts are finished in polished mahogany and are carefully screwed together. They will not fall apart or warp, as do the instruments of some manufacturers. Our "Senior" Loose Coupler will respond to wave lengths up to 1,800 meters, and with a loading coil 4,000 meters may be obtained efficiently. The secondary has 10 contact points varied by a large, rotary, rubber composition knob. The primary is varied by a slider. Size 5x6x12 inches. Shipping weight 10 pounds.

No. 1696 "Senior" Loose Coupler **$6.85**

A REAL TELEGRAPH OUTFIT $1.00



A remarkable little telegraph outfit that telegraphs TWO WAYS for a distance of one-quarter mile and more if sufficient wire and batteries are used.

A FASCINATING TOY
A Practical TELEGRAPH

The outfit includes instruments for two stations with keys and sounders, Morse Code Chart, Miniature Telegraph Blanks, full instructions and enough wire to start experimenting. Works with any dry cell or doorbell battery.

ANY ONE CAN LEARN TELEGRAPHY
Boys Can Have Great Fun

Price, complete as above; neatly packed in an attractive box..... **$1.00**

Do not confuse this outfit with those sold at a higher price for only ONE station. This outfit has TWO stations.

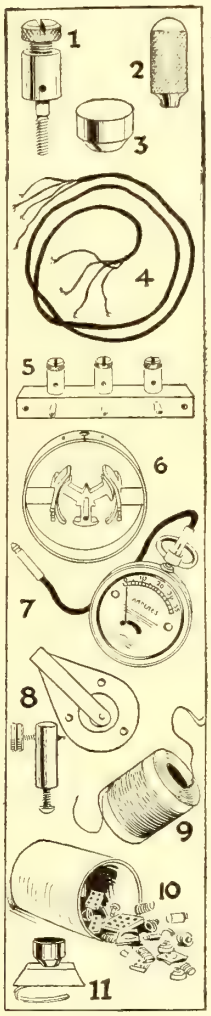
THIS FINE LITTLE ROTARY GAP $5.50



This Rotary Spark Gap is without an equal. It is made in every particular as well as any of the more expensive gaps, the only difference being the size. It operates in series with a 16 C. P. lamp on 110 volt alternating or direct current or from batteries. The Rotary Electrode is of cast aluminum alloy and is perfectly accurate. The wheel is mounted with genuine hard rubber on a heavy brass bushing which fastens to the motor shaft. The stationary electrodes are mounted on brass posts and are fully adjustable. Will stand ¼ K. W.

No. 476 Type "A" Rotary Gap, shipping weight 4 lbs..... **$5.50**
No. 477 Type "A" Rotary Gap, wound to operate on 3 dry cells..... **5.00**
No. 478 Three Inch Rotary Disc Only, mounted on hard rubber, with brass bushing, ⅛ in. hole; shipping weight 4 oz..... **1.50**

THESE PRICES WILL SELL THESE GOODS



Here are extraordinary bargains for experimenters. We want to dispose of them quickly. The prices are ridiculously low. Get out a memorandum and decide what you can use. Order now. Many were disappointed last month. The prices hold good only as long as the specials last.

No. 1—Binding Posts, ¾ in. high, handsomely nickeled, patented design. Worth 6c. ea. Special, ea. 2½c.; per doz., **25c.** Postage per doz., 5c.

No. 2—Hard Rubber Knobs, ½ in. in diam., threaded for 6-32 screw. Worth 3c. each. Have been used. Special, per doz. **10c.** Postage extra per doz., 3c.

No. 3—Hard Rubber Handles, ⅞ in. long, threaded. Have been used. Worth 4c. each. Handy in making apparatus. Special, per doz. **15c.** Postage per doz., 4c.

No. 4—Triple Receiver Cords, new; 4 feet long; contain 3 separate cords. No tips. Worth 50c. each. Special, postpaid **20c.**

No. 5—Connecting Blocks, genuine hard rubber with 3 handsome, nickeled binding posts. Useful for many purposes. Worth 25c. each. Special, each **9c.** Postage each, 3c.

No. 6—Motor Parts, consisting of 3-pole laminated armature and frame with pole pieces. Make your own motor. Parts worth 40c. Special, per set **10c.** Extra postage, 5c.

No. 7—Ammeter, 0 to 35 amperes; new and in perfect condition. Regular $1.25 value. Very special; while they last, **75c.** Postage extra, 5c.

No. 8—Spark Coil Secondaries, ½ in., spark length. Two assembled on a primary coil will give 1 in. Each one tested and in perfect condition. Make your own spark coil. A wonderful bargain. Worth 90c. each. Very special, each **30c.** Postage extra, 6c.

No. 9—Spark Coil Vibrators, for small coils only. New, perfect condition. Very special, complete **25c.** Postage extra, 3c.

No. 10—Experimenters' Handy Box, a splendid bargain; useful for all experimenters. Consists of a box containing between 40 and 60 odds and ends of electrical parts, coils, nuts, knobs, posts, rings, washers, etc. Useful in constructing apparatus of all kinds. We've sold hundreds of them. Every experimenter needs this box. An unusual and extraordinary offer. Get yours **now.** While the parts last, per box, postpaid **20c.**

No. 11—Sliders, for ¼-in. square rod; in good condition. Each **9c.** Postage, 1c.

Electro-Set "Arlington-Tested" Crystals

When testing out a wireless receiving installation for the first time, you want to know that your mineral crystal is sensitive. Then, too, why buy minerals on a gamble? Be sure of results—good results. Buy our "Arlington Tested" Crystals. Every one is tested for Arlington time signals. Each crystal comes in a sealed Metal Box and is carefully tested before leaving our factory. **Only one crystal in 20 passes our examination.** Arlington Tested Crystals are the most sensitive you can procure. They are worth the price. Each one is individually examined and packed.

No. 301 Arlington Tested Galena, individually packed and tested; postpaid **$0.15**
No. 302 Arlington Tested Silicon, as above..... **.15**
No. 303 Arlington Tested Bornite-Zincite Couple..... **.40**

ELECTRO-SET MINERAL ASSORTMENT, 50c.

Here's something every experimenter will welcome. Five different minerals, each in a metal container (5 boxes) for wireless detectors—only **50 cents,** postpaid! Included in this offer are the following minerals: Silicon, Galena, Molybdenite, Ferron and Carborundum. **Free** with each set, a piece of phosphor bronze detector wire. One of the most interesting experimental fields is in wireless detector minerals. Send for an outfit to-day.

CATALOGUES

SEND 4c. TO-DAY FOR OUR BIG NEW CATALOGUE containing description of dozens of new wireless and experimental instruments, parts and raw materials. Prices are new—instruments are new—a catalogue every experimenter MUST HAVE.

WRITE TO-DAY—SPECIAL CATALOGUES

Send **6c.** in stamps for our SPECIAL ELECTRIC TRAIN CATALOGUE, illustrating scores of models. Send 4c. in stamps for our Electric Vibrator and Medical Coil Catalogue.

WE ARE AGENTS FOR MARCONI USED APPARATUS

Send **5c.** in stamps for new, interesting catalogue of used Marconi Wireless Instruments at ridiculously low prices. We are agents for this line and can ship promptly anything from a Type "D" Tuner to a Motor Generator.

The Electro-set Co. Dept. 210, 1874 E. 6th Street, Cleveland, Ohio

YOUR RANGE
DEPENDS ON YOUR
RECEIVERS



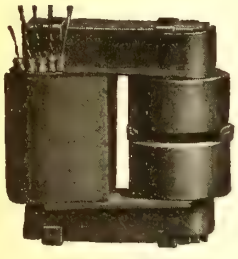


Holtzer-Cabot
Radio Receivers
have honestly earned their reputation of being the

"Most Sensitive Receivers Made"

Other features are light weight, comfortable shape, durability, perfect finish. Send for Booklet 20 D2 for description.

THE HOLTZER-CABOT ELECTRIC CO.
BOSTON — CHICAGO



UNMOUNTED TRANSFORMER

You Can Get Results with a small condenser and this transformer

It is a 1-2 K. W. size and is built on the same specifications as to material and workmanship, etc., as our big central station transformers.

Hundreds of stations are now using these transformers. This transformer gives you 13,200 volts.

Let us tell you how you can do part of the work yourself and get this transformer at a remarkably low cost.

THE PACKARD ELECTRIC CO.
555 Dana Avenue Warren, Ohio

ONE DOLLAR IN CASH GIVEN AWAY TO ALL who CUT OUT THIS ADVERTISEMENT and secure one of our $10 Four Volt 60 ampere (Christmas Tree Lighting) Storage Batteries for $4.45 at any of our three stores in New York. (Orders delivered or shipped by express $4.45 Net.) Electric Christmas Tree Lighting Outfits 95c. up. Lamps (all colors) 9c. up. Sockets 4c. up.

Broadway Electrical Novelty House, 421 Broadway, 129 West 125th St., 324 Bowery
CHEAPEST ELECTRICAL NOVELTY HOUSE ON EARTH

QUESTION BOX.

(*Continued from page* 504.)

your third question, and therefore cannot be of service to you.

Transformer Efficiency and Condensers.

(402.) Forbes St. John, Noroton, Conn., desires to know: 1. Which type of transformer is used most in wireless work? 2. A formula for calculating the capacity of condenser for any transformer with a given secondary voltage, etc.?

A. 1. Closed core transformers are used almost exclusively at the present time, because they have the highest efficiency and the arcing at the gap is prevented by rotary or quenched gaps. Open core transformers were used extensively at one time, but they were required, due to the fact that the science had not progressed to the point of using the rotary gap, and as open core transformers have a very sharp peak in their secondary wave form, they gave better results with the straight gap formerly in vogue.

A. 2. We give you herewith formula for calculating the necessary condenser capacity for any transformer with a given secondary voltage, etc.:

$$C = \frac{K.W. \times 10^8}{f \times Sec.\ Volts}.$$

In this formula, sec. volts is the secondary voltage of transformer; f is the frequency of the primary current of same; C is the capacity in micro-farads, and K.W. is the kilowatt rating of the transformer.

Poulsen Tikker and Aerial Construction.

(403.) C. M. Wickes, Bradford, Pa., asks for information on: 1. The Goldschmidt tone wheel and Poulsen tikker. 2. Which is the best way to connect an aerial, to leave the free ends of the strands open or to connect them together?

A. 1. You probably would do best to experiment with a "tikker" of the Poulsen type as described in the April (1915) issue of *The Electrical Experimenter* on page 228 thereof. When the Goldschmidt tone wheel is employed, no other detector is utilized, as you mention.

A. 2. It has come in practice to consider a wire grid aerial of the "L" or "T" type as simply a large capacity condenser and hence will be seen the idea involved in cross connecting the free ends of such aerials. In other words, they simply act as a large metallic spread which comprise a few wires spaced several feet apart, and it has been found that this gives practically the same effect as if the aerial were made of a broad metal sheet.

AN EXPLANATION.

We feel that an explanation is due to the readers of the *Electrical Experimenter* concerning the full page advertisement of the Electro-Set Co., Cleveland, O., which appeared in our December issue. Through a misunderstanding this full page ad was run in the November issue and, as stated in the original insertion, certain of the goods advertised were special lots at greatly reduced prices and orders could only be filled from quantity on hand. As additional quantities could not be furnished, we trust that those of our readers who have tried to order after certain stocks were exhausted will understand the circumstances. The Electro-Set Co. intends to act at all times in strictly good faith.

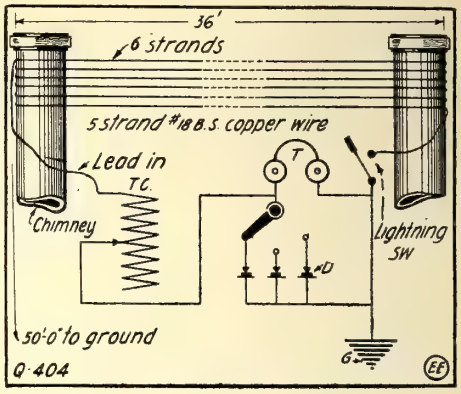
NEW SWEDISH RADIOPHONE.

Two Swedish army officers have invented a wireless telephone which is reported to have been used to talk from a moving train 740 miles, and it is to be used by aviators to connect them with their bases at all times while flying and to afford the commanders of warships means of direct communication.

Unique Aerial Construction.

(404.) C. Dyson, Roxbury, Mass., has sent us details of a peculiar aerial construction he has been using, and wishes to have our opinion on same.

A. We do not see how you can receive wireless signals at all, or at least it will be with very poor results, as your aerial apparently does not have any insulators on same. You should have all of the strands of your aerial insulated very carefully by



Novel Antenna Construction.

means of aerial insulators, or at least by some porcelain cleats. As the wireless currents are very weak indeed, it is extremely important that the aerial is very well insulated.

Transformer Design.

Francis De Kalb, Pine Bluffs, Mo., asks several questions regarding transformer construction for wireless purposes, particularly the action of the magnetic leakage type.

A. A transformer will work quite efficiently indeed in this manner, provided a variation in the output is controlled by adjusting the amount of primary inductance used.

The one-quarter kilowatt wireless transformer to be used under the requirements of the radio law, now in effect and specifying 200 meters wave length, should yield 12,000 to 20,000 volts preferably. This is necessary, owing to the very small condenser capacity, which is allowable in the oscillatory circuit, when 200 meters wave length is to be adhered to, and also in due consideration of the inductance which must be used in the circuit.

You may have as many taps in the primary winding of your transformer as desired; but, of course, it is not well to take taps from such a small number of turns that it will cause fuses to be blown, when the transformer is hooked up across the circuit.

Aerials for Air Craft.

(406.) Louis Schneck, New York City, desires information on the method employed by air craft for suspending their aerials when wireless messages are to be transmitted.

A. In aeroplane aerial construction a wire is generally run from the tips of the wings to the tail of the machine for an aerial, and for the ground a wire is dropped about 100 to 500 feet long from the bottom of the machine. This gives fairly good results.

In the larger types of the lighter-than-air machines, particularly the Zeppelins, a small aerial is erected above the gas bag, or a wire is suspended from each end of the machine, using one as an aerial and the other as a ground.

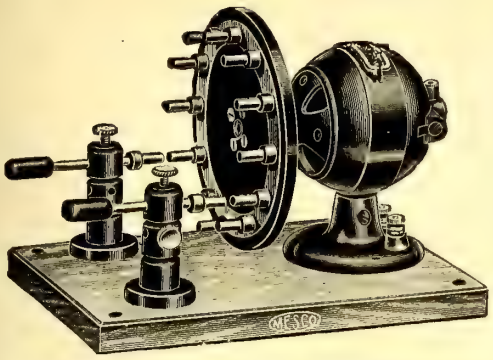
On Wireless Transmitters.

(407.) Orin F. Davis, Somerville, Mass., asks us: 1. What form of radio transmitter produces a hissing sound between the dots

(*Continued on page* 508.)

Be a Wireless Santa Claus to Your Boy

GIVE HIM WIRELESS APPARATUS GUARANTEED PERFECT OR MONEY REFUNDED



Mesco Rotary Spark Gap

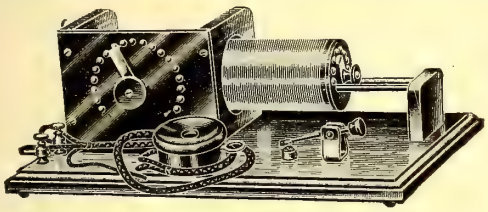
Emits a high musical note. Can be heard at greater distances than the note from the stationary type. Cannot be mistaken for static or other atmospheric disturbances. Produces pure wave of low damping decrement. Increases transmitting efficiency 20 to 30 per cent.

The rotating member has twelve sparking points mounted on a hard rubber disk and is carried on the motor shaft. Can be used on our spark coils or transformers up to 1 K. W. Has two stationary electrodes with special adjusting devices.

Our Globe Motor is used. Will operate on 110 A. C. or D. C. circuits; speed of 4,500 R.P.M. Also made with our Globe Battery Motor, which can be operated on a six-volt circuit.

List No.		Price.
222	Mesco Rotary Spark Gap, 6 volt	$12.00
223	Mesco Rotary Spark Gap, 110 v., A. C. or D. C.	13.00
216	Rotary Unit Only, with two Stationary Electrodes, 1 3/16 in. shaft	5.00

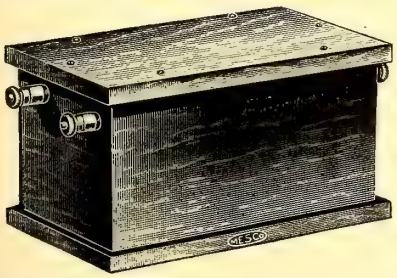
Manhattan Wireless Receiving Set



Consists of a loose coupler, fixed condenser detector, and an 80 ohm receiver with cord. Will tune up to 1,800 meter wave length on a 60-foot aerial. Can be tuned to waves over 4,000 meters with larger aerial and properly connected to loading inductance and variable condenser shunted across the secondary of the receiving transformer.

List No.		Price.
210	Manhattan Wireless Receiving Set	$10.00

Mesco Intensifying Transformer

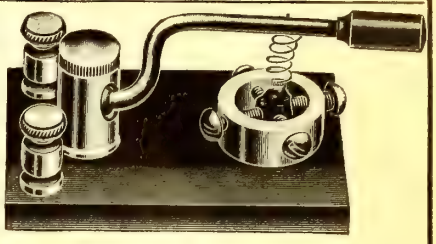


Used for intensifying signals received from any crystal detector by connecting an audion detector on the other side of the transformer winding. Used between two audion detectors, signals will be intensified 10 to 25 times.

As many as three of these transformers can be connected between audion detectors in cascade, forming an intensifier, making it possible to read signals not heard with any single known detector. Diagram of connections with full directions with each instrument.

List No.		Price.
224	Intensifying Transformer	$12.00

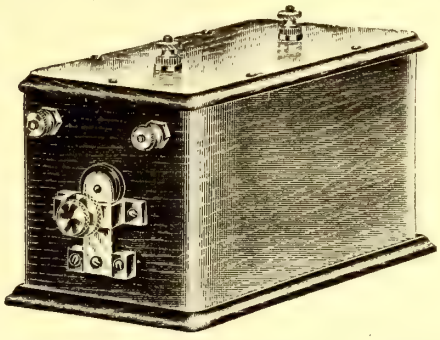
Mesco Universal Detector Stand



Has a heavy brass cup, with four binding screws; will hold crystals up to ¾ in. diameter. A hollow standard encloses a brass ball. Through an opening a brass arm with hard rubber handle is secured fast to the ball, making a ball and socket joint, allowing it to be adjusted at any angle or used in any position.

Hard rubber base 2¼x4¼x⅜ in. All metal parts nickel-plated. Remains permanently in adjustment under jars and vibrations of every description.

List No.		Price.
248	Mesco Universal Detector Stand	$3.00



Mesco Wireless Spark Coils

Have low current consumption. Best to operate on dry batteries. Contact points of heavy platinum iridium. Has primary condenser in case. Made for wireless work. Permits of close tuning. Spark at interrupter reduced to a minimum, spark is heavy; made in ¼-inch to 4-inch sizes. Our Manual gives all the technical points.

List No.		Price.
462	Spark Coil, 1 inch; can be operated on 6 Red Seal dry batteries	$5.40

Send 10c. for Copy of Our Wireless Manual No. 9

YOU GET YOUR MONEY BACK ON AN ORDER OF $1.00

It contains 120 pages and tells how to erect and maintain wireless telegraph stations. Shows a number of diagrams. Has the Morse and Continental Telegraph Codes. Illustrates the best instruments to use; tells what they are for and how to use them. Has many new diagrams and other valuable information not contained in any other book. Do not wait. Send your request now.

Get the Best 10c. Value You Will Ever Buy

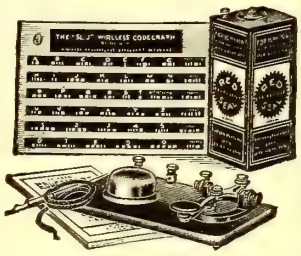
SEND FOR OUR POCKET CATALOG, W 28

It contains 248 pages, 1,100 illustrations and costs you nothing.

IT MEANS MONEY SAVED TO YOU

to have our Manual and our Catalog when you want to buy.

Mesco Codegraph



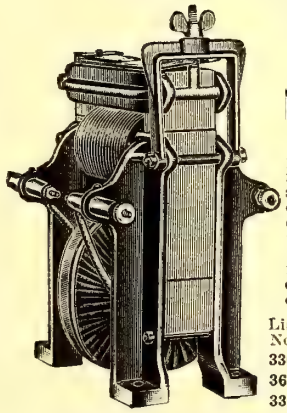
A dandy practice set for the beginner. Just the right kind for the apt boy.

The Codegraph Plate is of metal with insulated dots and dashes. The Pen is connected with the Red Seal Dry Battery and the Wireless Practice Set. When the pen is drawn across the dots and dashes it closes the circuit, and the buzzer sounds. It is possible to attach a sounder to the outfit and get the telegraph click also. A practical and efficient way of learning wireless and telegraph signals.

List No.		Price.
303	Mesco Codegraph Set	$2.50
304	Codegraph Plate, Pen and Book	1.00

MANHATTAN ELECTRICAL SUPPLY CO.

New York, 17 Park Place. Chicago, 114 S. 5th Ave. St. Louis, 1106 Pine St.
San Francisco Office, 604 Mission St.



Mesco Flexible WIRELESS TRANSFORMERS

Will make wireless apparatus 200 per cent. more efficient. When short circuited or when charging condensers does not consume any more power than the magnetic shunt is set for. Can be connected direct to alternating circuit.

List No.	Capacity.	Secondary Voltage.	Pr.
330	½ kw.	5,000 v.	$15
363	¾ kw.	10,000 v.	20
331	1 kw.	20,000 v.	25

Mesco Wireless Receivers

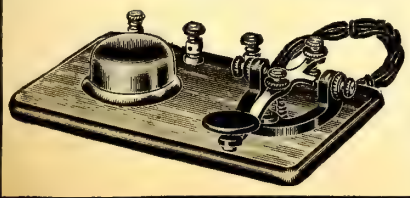


Have powerful field magnets and thin diaphragms, and are very sensitive. Our No. 480 Double Head sets complete have been used in receiving commercial wireless messages over distances of 2,000 miles. All receivers are wound with silk-covered copper wire.

Best steel obtainable used in construction of the permanent magnets. Users have had head sets for five years and over without any deterioration in sensitiveness. This cannot be said of any light-weight receivers.

List No.		Price.
480	Double Head Band, with six-foot green silk cord and two receivers, 4,000 ohms each	$6.00

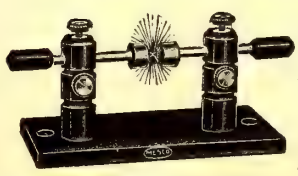
Mesco Wireless Practice Set



Comprises a regular telegraph key, without circuit breaker, a special high pitch buzzer, one cell Red Seal dry battery, and four feet of green silk-covered flexible cord. The main object of the set is to enable the beginner to master the wireless code, and the buzzer reproduces the sound of the signals of the most modern wireless stations perfectly.

List No.		Price.
342	Wireless Practice Set, with battery and cord	$1.50

Mesco High Efficiency Spark Gap

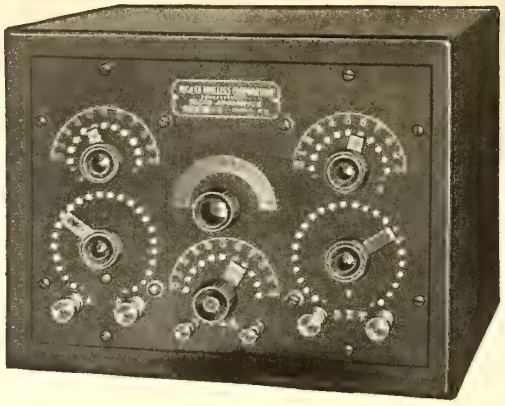


Adapted for stations up to ¼ K.W. capacity. Base is of polished hard rubber. Standards are of hard rubber composition of the highest insulating properties. Hard rubber ends on the brass rods permit the length of the gap to be varied, while sending. Spark terminals are of zinc, and are renewable.

List No.		Price.
465	High Efficiency Spark Gap	$3.00

"MIGNON SYSTEM"

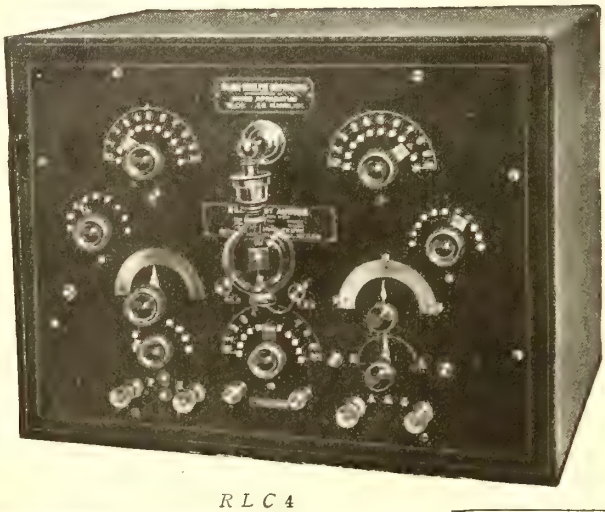
Radio Signal Receiving Apparatus



R L C 2 Special

For Commercial and Amateur Wireless Stations

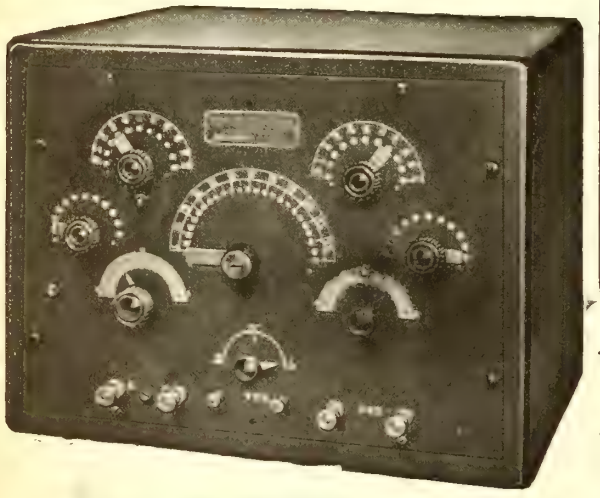
WRITE FOR CATALOG R5



R L C 4

Apparatus of Scientific Construction for the Reduction of Static Interference.

High Resonance Unapproached Selectivity and Durability



R L C 3 Special

The "Mignon System" Radio Receiving Cabinets RC2—RLC2 Special—RLC3 Special and RLC4 are not guaranteed for the reception of continuous wave signals. However, through the persistent efforts of our untiring laboratory staff, they have been decidedly improved upon, with the gratifying result of being able to hear the above signals in our daily tests of apparatus before shipment is made. These signals will greatly improve by the shunting of a fixed or variable condenser of suitable capacity across the 'phone terminals.

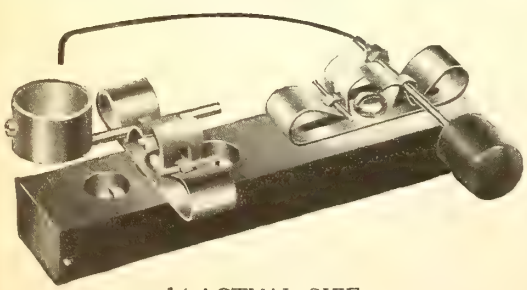
We receive many gratifying letters from our satisfied patrons verifying the above statement.

Mignon Wireless Corporation

Specialists in Radio Receiving Apparatus

127 West Market Street

ELMIRA, N. Y.



½ ACTUAL SIZE

POSTPAID, 50 CENTS

"SOME" DETECTOR!

Absolutely the **simplest** and **most practical Detector** of the Cat Whisker type yet devised. Lacquered Brass for the metal parts and Polished Fibre for the base. Has the usual merit of the **"Winger"** products.

Winger Electric & Mfg. Co.

711 So. Dearborn Street, Chicago, Ill.

QUESTION BOX.

(Continued from page 506.)

and dashes, the latter being somewhat more intense? 2. What form of winding is most efficient for a loading or coupling coil, the straight coil or the layer wound? 3. Wave length of tuning coil 10 inches long by 3½ inches in diameter, wound with No. 20 bare wire?

A. 1. The peculiar note you hear in your 'phones is due to the compensating wave emitted by arc transmitting stations. In this system the key is shunted around a few turns of the helix, and when the key is closed it throws the aerial circuit in tune, and when the key is raised the aerial is out of tune, but you can hear the waves emitted, although they are much weaker. This method of control is necessary when it is considered that the arc must be continually burning, and any interruption of the circuit would perhaps extinguish the arc. Therefore, all of the controlling is done in the aerial circuit, but no means can be used which will alter the amount of current drawn from the arc.

A. 2. The best form of winding for inductances in general is the single layer winding, as this cuts down the distributed capacity effect.

A. 3. The wave length of the tuning coil you mention is approximately 200 meters.

Miscellaneous Radio Phenomena.

(408.) Russell Baley, Hillsboro, Wis., desires to know: 1. Why it is that the color of his spark gap changes from blue-white to a yellowish hue when the aerial is disconnected from same? 2. An explanation of why a 220-volt, 75-k.w. alternator has the effect of attracting a 25-watt lamp suspended three feet above it. The latter being equipped with a tin shade.

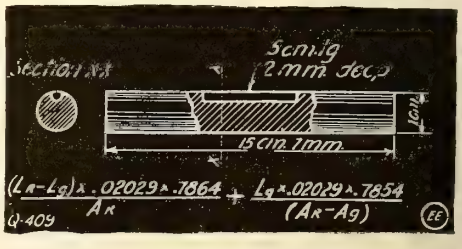
A. 1. When the aerial is connected to your spark gap it acts as a capacity and increases the intensity of the discharge, but when the aerial is disconnected this capacity is removed and the current merely arcs in the gap.

A. 2. The large generator, having a powerful magnetic field, will no doubt attract the lamp, due to the tin shade on same, but as the current also sets up a magnetic field around the lamp when it flows through the filament this may also be a factor in the attraction of the lamp. Magnetism might be set up in the tin shade, also, by induction currents flowing around it.

Resistance Formula.

(409.) Roy Ostend, Wurtsboro, N. Y., ask for a formula to be used in calculating the resistance of a rod, the dimensions of which are given in the attached illustration.

A. The formula for calculating this rod is given in the sketch.



Formula for Calculating Resistance of Slotted Bar.

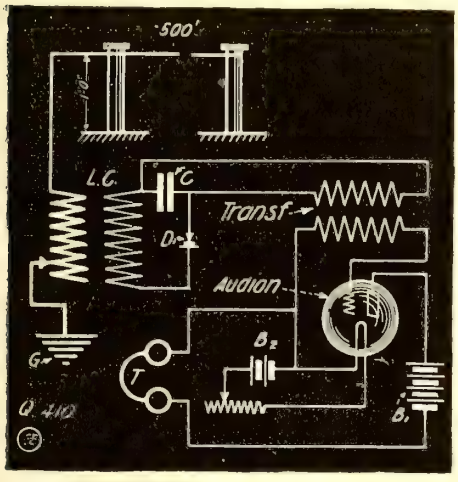
In this formula Lr is the length of the rod over all in cms., Lg is the length of the groove in cms., Ar is the area of the rod in sq. cms., and Ag is the area of the groove in sq. cms. The other figures are

constants. The resistance calculated by this formula will be the resistance of a copper rod of the above dimensions. Other metals may be figured by multiplying this result by the relation of this metal's resistance to that of copper. Thus, if the rod is of 18 per cent. German silver, the result should be multiplied by 18, because the resistance of this metal is 18 times as great as that of copper.

New Type of Aerial.

(410.) U. R. Fox, Dobbin, Tex., informs us that he has read of an antenna made by laying a wire straight on the ground, and that the inventor of this method was enabled to pick up Honolulu when the aerial was tried in California.

A. To the best of our knowledge the wire employed for such experiments is raised about one foot from the ground on posts and is insulated. In some cases the far end of the wire is grounded. We believe that this will work all right, provided a detector is used that operates on the current-effect principle and that the rectified current obtained be intensified by using one or two audion amplifiers. We are attaching



Single Wire Aerial and Audion Amplifier Hook-up.

an illustration which will no doubt be of assistance to you in your experiments.

Spark Coils as Open Core Transformers.

(411.) Peter J. Welcome, Port Jefferson, N. Y., writes us, asking several questions: 1. Why it is that he can obtain a spark from the secondary of his induction coil when same is connected direct to the 110 volt, alternating current mains and vibrator is screwed up tight? 2. Why it is that a small condenser connected across the 'phones has the effect of cutting out the signals? 3. What effect the wide spacing of his aerial wires will have on receiving range, and if the addition of more wires will increase the range?

A. 1. When a spark coil is connected direct to the 110-volt, alternating current mains and the vibrator is screwed up tight the coil will operate as an open core transformer; but it will be very inefficient, due to the fact that it is not properly designed for such work.

A. 2. The condenser connected across the 'phones should be in series with a switch, which will enable you to cut out the instrument under certain conditions.

A. 3. It will be of no advantage to add three or more wires to your aerial, for it should give very good results as it is, and the addition of more wire will not merely lower the inductance, but will increase the capacity also and the gain thereby will be very little.

Converting Transformers from Open Core to Closed Core.

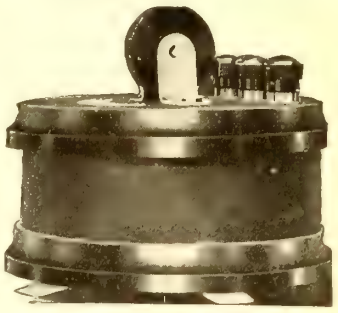
(412.) Lamar Boyett, Tampa, Fla., writes

CRYSTALOI

A PERMANENT WIRELESS DETECTOR THAT HAS MADE A WONDERFUL RECORD

The **CRYSTALOI DETECTOR** will do for you exactly what you would have a detector do. It will put you in touch with the *Distant Stations*. It is not affected by near By-Stations. It is capable of the finest adjustment and will last a lifetime if properly cared for. We guarantee every instrument to be and do everything we claim for it. Ask any one of the thousands that are using them—they are all for us.

TYPE AA. SUPER-SENSITIVE



DIMENSIONS 4" x 3½".

PRICE, $6.00

Mailing Weight, One Pound



CRYSTALOI—Type 0
$3.50—Postage, 10 Cents

OUR NEW MINIATURE WIRELESS CATALOG describing our complete line of Receiving Apparatus can be had for five cents in stamps.

REMEMBER WE ARE SPECIALISTS in wireless Receiving Apparatus and our products are of the highest grade obtainable.

EUGENE T. TURNEY CO., Inc.
2595 THIRD AVENUE, NEW YORK CITY

Here's the Most Sensitive Head-set for Wireless Work



On 10 Day Free Trial

Stromberg-Carlson Radio Head-Set

THIS set is guaranteed to increase the receiving efficiency of any radio station with which it is used, regardless of the type of head-set used heretofore.

This claim is based on comparative operating tests conducted at many stations. If you are skeptical, convince yourself by ordering a set for 10 days' free trial against all other makes. The price is $8.25, and your money will be given back at once without the slightest obligation if you are not satisfied.

Dealers sell this head-set. If you cannot get it from your dealer, write us. Write today for free bulletin No. 1006.

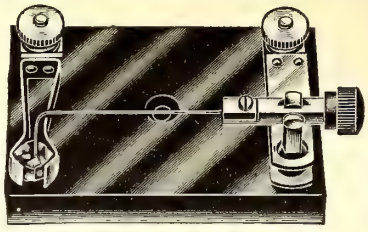
Stromberg-Carlson Telephone Mfg. Co.
Rochester, N. Y. Chicago, Ill.

2 NEW BUNNELL WIRELESS SPECIALTIES

The Jove Crystal-Detector-Holder is the simplest, handiest and most perfect arrangement yet produced. It holds crystals **without using clamp screws.**

It firmly holds crystals of different minerals at the same time—change of contact from one to the other can be instantly made; a sensitive point quickly found, and the correct pressure held constantly, all without using a single screw or nut. It is designed and finished in our well-known high grade style. Mounted on dark **enameled porcelain base** with metal parts nickel-plated and highly polished.

Price, Net $1.00



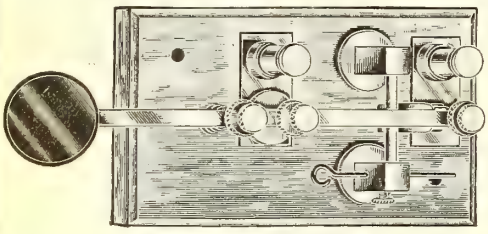
Jove Crystal-Detector-Holder.

The Straight-Line Renewable-Contact Radio Key is much superior to other types of Radio Keys.

Not only are the contacts renewable; but, no matter how much worn, full contact surface can be maintained between them, and the lever retains its normal horizontal position.

This is accomplished by mounting the upper contact on an adjusting screw, which is threaded through the lever and held in position by a check nut. The lower contact is so arranged that it may be loosened for adjusting.

By holding the lever down, with lower contact loose, and then clamping it, perfect surface alignment between the faces of contact pieces is secured, and thus fading or irregularity in strength of signals caused by varying resistance of contact points is eliminated and the contact pieces may be practically used up before renewal becomes necessary.



Straight-Line Radio Key.

Another desirable feature of our Straight-Line Radio Keys is the self-clamping binding posts with which they are equipped. These posts make loose connections impossible.

The Keys are mounted on heavy, **polished marble bases** (6 in. x 3½ in. x 1 in.). The metal parts are heavily nickel-plated and polished, making a strikingly handsome symmetrical instrument.

Price, with ⅜ in. hard silver contacts; postage weight, 4 lbs..... net, **$7.50**

Send for descriptive circular and copy of our Wireless Catalog.

THE J. H. BUNNELL CO., Inc., Electrical Manufacturers, 32 Park Place, New York City

This Highly Efficient Jeweler's

TIME RECEIVING STATION

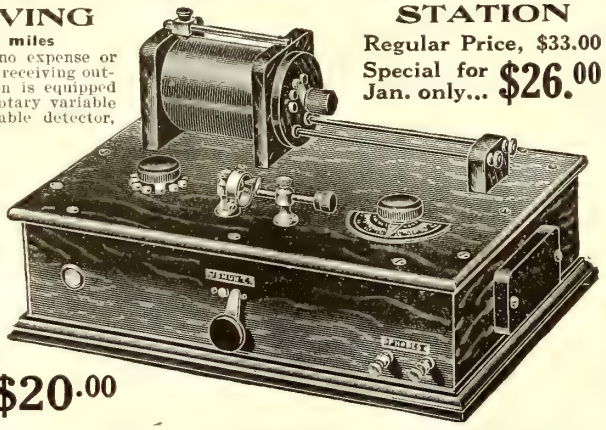
Will receive up to 2,000 miles

Regular Price, $33.00

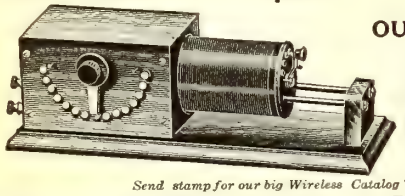
Special for Jan. only... $26.00

In this set we have spared no expense or labor in construction. As a time receiving outfit it has no equal. The station is equipped with a 12-point loose coupler, rotary variable condenser, new feature adjustable detector, fixed condenser, large capacity loading coil, including a 2,000 ohm D. P. Headset.

All instruments mounted in a specially constructed oak cabinet 16½ inches long, 12 inches wide by 10 inches high over all. A buzzer is connected so as to enable you to secure proper adjustment in your detector in order to receive wireless. This station is fully guaranteed to give you satisfactory and reliable service



Complete Parts for this Station all wound and drilled ready to put together and start to work, with full directions. **$20.00**



OUR JOVE RECEIVING TRANSFORMER

Regular Price, $8.00; for January only $5.00

This is a very superior transformer. Has 15 taps brought out to contact Points mounted on the side of the primary cabinet and controlled by a quick acting radial switch—making rapid variation a feature. The secondary is wound with fine silk covered wire having 6 taps brought out to the contact points on the end of the drum and controlled by a quick acting, self-adjusting spring type lever. The secondary is direct connected to binding posts mounted on the back of the primary cabinet, thus avoiding noises in the receivers and breaks in the message due to loose and imperfect contacts.

COMPLETE PARTS, all wound and ready for assembling. **$3.50**

Send stamp for our big Wireless Catalog "E" and free code chart made of unbreakable fibre.

Universal Wireless Co. 19 E. 32 Street N. Y. CITY

All "Universal" sets are sold with 10-day trial privilege and money back guarantee. Prompt shipment guaranteed.

RADIO-UN-DAMPED-WAVER

DO YOU WANT TO HEAR

Nauen, Hanover, San Francisco, Honolulu, Darien, Sayville and Tuckerton on just an ordinary aerial . . . . .

You can do it on our instrument

TEAR THIS OUT AND SEND FOR CIRCULAR

UNIVERSITY APPARATUS CO. 275 MORRIS AVE. ELIZABETH. N. J.

us, asking for instructions for converting a transformer coil into a closed coil transformer.

A. This may be very easily accomplished by following the design shown herewith. A



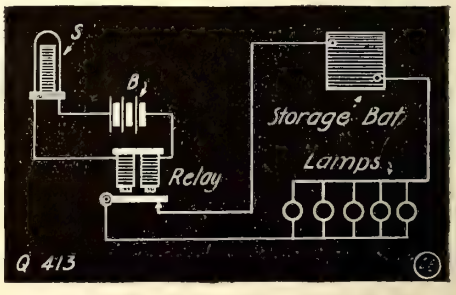
Making Closed Core Transformer from Transformer Coil Secondaries.

square core should be built up of transformer iron in the usual manner. It should be made of such dimensions that it will fit inside the secondary of the transformer coil, the holes in which measure 1½ inches in diameter. The core should be insulated under these coils with three or four layers of Empire cloth or silk. The primary consists of four layers of No. 16 D. C. C. wire wound on the opposite leg of the core, as shown.

Automatic Control of Sign Lights.

(413.) J. F. Jones, Ontario, Canada, wishes information on a method by which he can control electric lights on a sign placed some distance from his home. The arrangement is to turn the lights on at night and switch them off in the morning and is to be used for advertising purposes.

A. One of the methods by which this can be accomplished is to use a selenium cell, and the sketch herewith shows the wiring to be used. The cell is shown at S; B is a battery of 10 or 15 volts (determined by experiment), a relay and a storage battery supplying the lights. During the daytime the current will be flowing through the selenium cell and the relay will hold the contacts open. At night the cell will increase its resistance and the contacts will be closed, thus lighting the lamps. The circuit will again be opened in the morning as soon as the sun's rays strike the selenium cell.



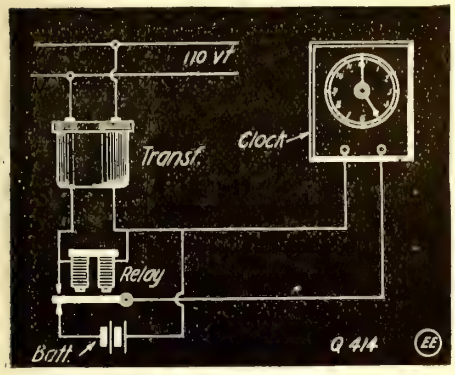
Using Selenium Cell to Turn Lamps On and Off at Sunrise and Sunset, Respectively.

It is well known that a selenium cell becomes more or less fatigued when exposed for long stretches at a time to strong light and will fail to respond; to offset this we suggest the use of a cell shielded by a

semi-opaque substance, which will prevent the direct rays of the sun from falling on same, and thus the life of the cell will be appreciably increased.

Automatic Clock Switching Mechanism.

(414.) Irwin C. Ryan, Elgin, Ill., writes us, asking for a method whereby he can



Relay Scheme for Transfer of Power to Electric Clock.

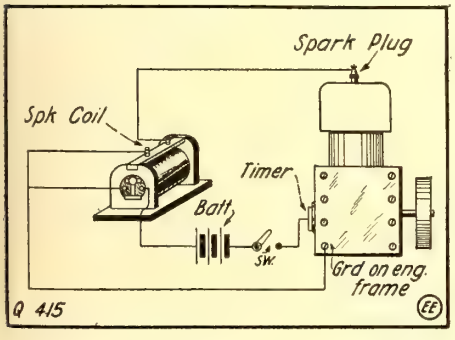
switch an electric clock, that is normally operated from a step-down transformer, to a set of batteries when the alternating current is cut off by accident or otherwise.

A. We are giving herewith a diagram of an arrangement by which you can switch your electric clock from the transformer mains to batteries, so that the clock will not stop when the lighting current goes out of commission. The method shown utilizes a relay. As long as the lighting station supplies current the armature is held away from the contact and the clock is operated by alternating current. However, should this circuit be opened, the armature will drop, making contact and thus closing the circuit through the batteries. When the alternating current starts to flow again, the armature will be attracted, thus breaking the circuit. The relay used should have a resistance of about 1,000 ohms to prevent undue draw on the transformer's secondary, and the spring on the armature of the relay should be very carefully adjusted.

Gas Engine Ignition.

(415.) Elmer D. Gehman, Macungie, Pa., wishes information on how to connect a spark coil to a single cylinder gas engine for ignition purposes.

A. The accompanying diagram shows the method of wiring an ordinary spark coil to a gas engine for ignition purposes. The hot spark delivered by these jump spark coils



Jump-Spark Coil Hook-up for Gasoline Engine.

will prevent, to a large extent, carbon deposits and will give more power in the engine.

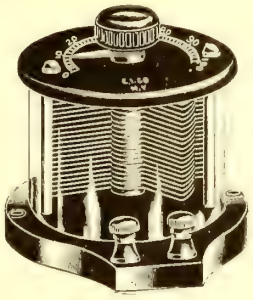
General Radio Queries.

(416.) Harold Brown, Walden, N. Y., asks: 1. Can a rotary spark gap be used

Chicago Wireless Headquarters

CLOSING OUT LARGE LINE OF RAW MATERIALS, PARTS, Etc.

ROTARY VARIABLE CONDENSERS



Only transparent rotary variable condenser made that can be screwed down, filled with oil to increase capacity and has binding posts on bottom where they belong. The 43 plate condenser has a capacity of .001 m.f. The 17 plate has a capacity of .0003 m.f.

No. 9240—17 Plate Rotary Variable Condenser, $2.25
No. 9241—43 " " " " 3.75



No. 10. TUNGSTEN FLASHLIGHT
6 inches long, complete .....65c.
Extra battery....20c. Extra bulb....15c.

60 and 100 Watt Nitrogen Lamps use less current; give white light.
60 Watt.....85c. 100 Watt.....90c.



No. 125. TUNGSTEN NICKEL VEST POCKET FLASHLIGHTS with Tungsten bulb and Ever-Ready Battery, complete.....45c.
Extra bulb, 15c. Extra battery, 20c.

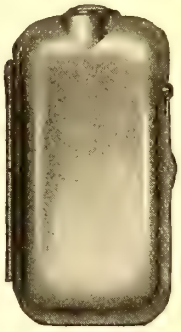
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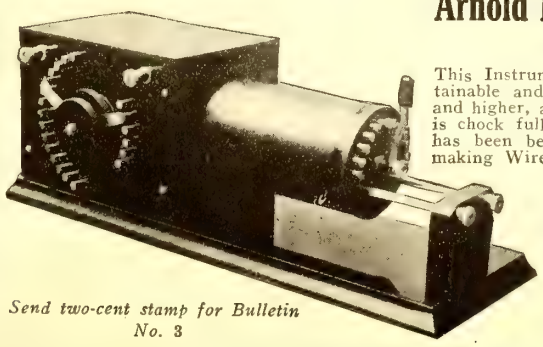
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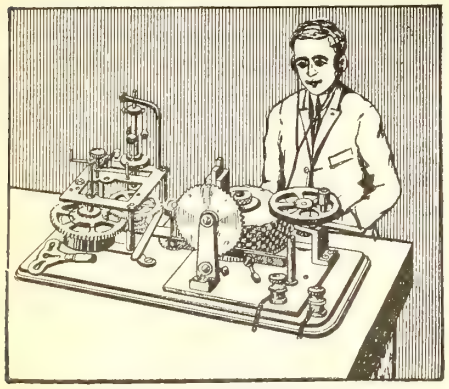
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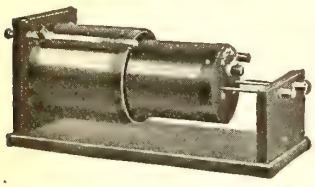
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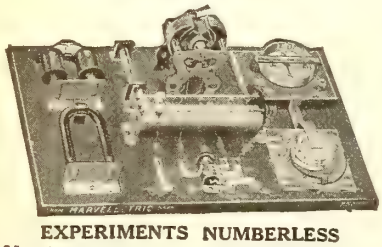


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with a small spark coil? 2. What is the wave length of his aerial 125 feet long and having a mean height of 43 feet? 3. The best size aerial to be used for all-around amateur work.

A. 1. A rotary gap cannot be used on a spark coil, due to the fact that the interruptions in the primary occur independent of the time when the plugs on the gap are in the sparking position, and if no plugs are opposite when the break occurs no spark will occur and the note will thus be badly broken up and distorted.

A. 2. The wave length of the aerial you describe is approximately 250 meters.

A. 3. For all-around amateur work it is advisable to have two aerials, one between 250 and 500 feet long and comparatively low, say, 40 feet, and the other about 80 feet long and 70 to 80 feet high. The former is to be used for receiving long wave lengths from high-powered stations, and the latter for transmission purposes and the reception of amateur signals.

Direct Current on Arc Lamps.

(417.) Osmond S. Ryer, Pasadena, Cal., wishes to know: 1. Why alternating current is changed to direct current for operating motion picture machines? 2. How motor generator sets change alternating current to direct current?

A. 1. Direct current has been found to be superior to alternating current for feeding arc lamps, due to the fact that less current is consumed, and the light emitted is much stronger and whiter than from arc lamps operated on alternating current.

A. 2. A motor generator set consists of an alternating current motor and direct current generator mounted on the same base with their shafts connected. The operation of this machine is as follows: The alternating current is fed to the motor and, of course, drives same. This motor, in turn, drives the generator which generates direct current and is used on the arc. The alternating current does not flow over the shaft of the machine, and there is no electrical connection between the two machines.

HUTCHISON, EDISON'S CHIEF ENGINEER, ON NAVY BOARD.

Dr. Miller Reese Hutchison, of Llewellyn Park, West Orange, chief engineer for Thomas A. Edison, recently received appointment to membership on the Naval Advisory Board. Dr. Hutchison is the second to be appointed by Secretary Daniels, the first being Mr. Edison. Other members of the board have been selected by groups of scientists.

Dr. Hutchison was born in Montrose, Ala., Aug. 6, 1876, and was educated at the Marion, Ala., Military Institute. He took a technical course in the Alabama Polytechnic Institute, and was graduated in 1897. While in school he invented a device for assisting the deaf to hear that won him recognition. He attended the coronation of King Edward in 1902 and was presented by Queen Alexandria with a gold medal in recognition of a device he invented that helped her to hear, for she was quite deaf.

He is a member of the American Society of Mechanical Engineers, the Society of Automobile Engineers, the American Institute of Radio Engineers, the National Geographic Society, the Engineers Club of New York, the National Institute of Social Sciences, the New York Electrical Society, the American Society of Naval Engineers, the Navy League of the United States, and the American Association for the Advancement of Science.



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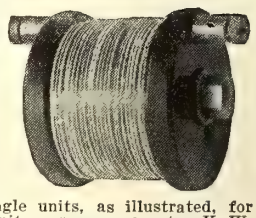
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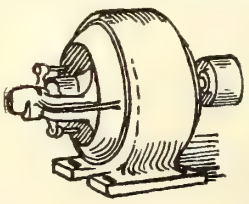
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PATENT ADVICE

Edited by H. GERNSBACK

In this Department we will publish such matter as is of interest to inventors and particularly to those who are in doubt as to certain Patent Phases. Questions addressed to "Patent Advice" cannot be answered by mail. Sketches and descriptions must be clear and explicit. Only one side of sheet should be written on.

TELEPHONE DIAPHRAGM.

(39.) C. G. Black, Worcester, Mass., has sent us a sample of a telephone receiver diaphragm perforated in a certain manner. Our correspondent claims that by so perforating it will become more sensitive, particularly when used for receiving wireless telegraph signals.

A. We have examined the diaphragm and we have also tested it, and admit that it works slightly better than the ordinary receiver diaphragm. We should think that it would be possible to exploit this commercially, as an article of this kind is surely in demand.

We would advise our correspondent to apply for patent on this device, but it would perhaps be a good idea to first have a search made to find what has been done in the art before. There are a great many telephone receiver patents as well as patents on telephone diaphragms, and it is always safe to investigate what predecessors have done in the art.

REINFORCING STEEL RAILS.

(40.) J. M. Bennet, Mt. Washington, Pa., sends in a device on reinforcing steel rails for heavy track service. He also encloses a detailed drawing on same and wants to know if the invention is patentable and practical.

A. Devices of this kind are in use practically all over the world wherever the tread has to stand a heavy load. There is nothing new to this and it is being used in ordinary every-day practise.

DETECTOR.

(41.) Fred R. Bullis, Omaha, Neb., submits an idea on a new detector whose operation is based upon using sponge platinum in a certain manner.

A. Without practical research work it is impossible to state if the device will work or not. On wireless detectors or any device of this kind speculation is of little use, as it is impossible to foretell whether such a device will work or not. The scheme looks feasible on paper the way our correspondent puts it, but as stated before, without practical experience it is fruitless to go into the merits of the invention. We would advise our correspondent to experiment with the device, by all means, and in case encouraging results are obtained apply for patent. This is the best suggestion we have to offer now.

INTERCOMMUNICATING 'PHONE.

(42.) S. A. Vedri, New York City, has invented a new intercommunicating direct-line telephone which is supposed to do away with the ordinary telephone receiver, the idea being that by pressing a button the sounds will come out of a horn. A super-sensitive transmitter is used, so the person does not actually have to speak into the mouthpiece but can be as far as 2 feet away from it. He wants to know if such a device is practical and whether there is a demand for same.

A. Without knowing the full details of this scheme it is impossible to say whether a device of this kind can be patented or not. The mere idea of using a loud-talker in connection with a very sensitive microphone does not entitle you to a patent, as such devices have been used right along in every-day work. If, however, the interior (operating) mechanism of the telephone represents a new idea not having been used before, a patent might be obtained. We advise you to get in touch with a reputable patent attorney to look up the art and see what has been done previously.

FRANCE TO MOBILIZE INVENTORS ALSO.

A minister of inventions whose duty it is to effect a mobilization of the inventive genius of the country is the latest project of the French Government. It is one of the new necessities of modern warfare just as England's new minister of munitions. The plan is similar in some respects to that adopted in America by the formation of the naval advisory board.

From this it must not be inferred that France is suffering from a dearth of war inventions. It is quite the contrary that has given rise to this fresh need. The principal task of the minister will be the sorting out of the more important of the thousands of war devices with which the French patent office is being flooded and the quick placing of them at the disposal of "la patrie."

X-RAY MAY STOP CANCER'S RETURN AFTER OPERATION.

That the X-ray apparently has no effect on cancer itself, but that it will stimulate the growth of lymphocytes, a sort of white corpuscle, and thus prevent a recurrence of cancerous growth, was stated in a paper read by Dr. James B. Murphy, of the Rockefeller Institute to the members of the National Academy of Sciences at the American Museum of Natural History recently.

Dr. Murphy reached his conclusions after many experiments with rats. The treatment, he hopes, will be found of value when applied to humans from whom cancerous growths have been removed.



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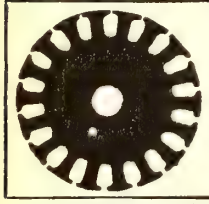
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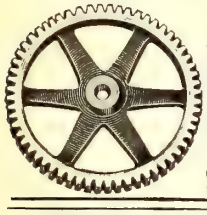
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PERPETUAL MOTION, THE FOLLY OF THE AGES.

(*Continued from page 480.*)

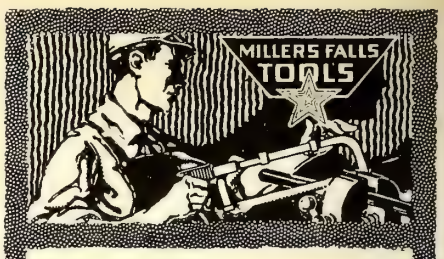
chine must of necessity be supported on spindles or shafts resting in bearings. These bearings are bound to exert some frictional effect, and the following formula gives the loss in foot-pounds per minute for such horizontal bearings. This rule states that the loss in foot-pounds per minute is equivalent to .2618 times the coefficient of friction, times the weight on the journal in pounds, times the diameter of the shaft in inches, multiplied by the revolutions per minute at which the shaft rotates. The value of the coefficient of friction varies, of course, but it has a value of approximately .008 for a cast-iron shaft running in a steel box or sleeve when the pressure is 100 pounds per square inch, and, considering that sperm oil is used as the lubricant.

Many people who have a slight knowledge of physics have promulgated designs for perpetual motion employing liquids, somewhat after the fashion shown in Figs. 2 and 3, and some of these machines have appeared to be very ingenious on first inspection. However, friction is also present here, as liquid cannot flow through a pipe or nozzle without encountering a reactional or frictional effect.

A number of electrical machines intended to produce perpetual motion have been devised from time to time, and Fig. 4 depicts a design which might appeal to the amateur electrician or inventor. This instrument is of the electromagnetic type, and A represents a frictional electrical machine. At B there is a crank connected to a pivoted armature situated in front of the electromagnet C. The frictional electric machine is started and so magnetizes the (temporary) magnet, which pulls the armature G toward C; the circuit is broken at E, and thus the magnet loses its power, temporarily. The spring J now pulls the armature back against the contact screw E, and thus the magnet is energized once more. Thus the action is supposed to keep up forever. The explanation previously given in connection with the motor-generator set illustrated in Fig. 3 will help to elucidate the fallacy here involved. Besides a static machine cannot operate an electromagnet.

Another inventor devised a magnetic wheel machine, pictured at Fig. 5. This wonderful machine constituted a rotating wheel having oppositely disposed magnetic segments, such as those made of iron (A), while a powerful steel magnet acted on these wheel segments in turn. Attached to the wheel shaft was a crank motion which alternately and in proper sequence raised and lowered a magnetic shield (B) in front of the permanent magnet poles, so that as soon as the iron segment approached the magnet the shield would be interposed between them, and the momentum of the wheel would carry it past this point, etc. This action was repeated *ad infinitum*, as will be apparent. The most remarkable claim made by the inventor of this particular device was that the magnetic shield was to be composed of brass, coated with a "chemical and mineral substance" which would make it an insulator of magnetism. (As a matter of fact there has never been found a substance to insulate magnetism, except iron.) Again, the wheel C attached to the shaft of the device turns in a trough of water, as perceived, and it is supposed to serve in equalizing the motion, thus keeping the machine from running away with itself and committing self-destruction!

One of the "simplest," apparently, solutions of the perptual motion problem and devised at an early date involved the use of some form of revolving wheel made up with spiral paths in same, in which paths



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a number of metal weights or balls could travel back and forth as the wheel rotated, and thus change their center of gravity. This would eventually overbalance the wheel proper, it was claimed, so that they would produce a greater force on one side of the wheel (in a descending sense) than that offered by the balls being raised on the other side of the wheel. This is shown very clearly in Fig. 6. Moreover, the friction and windage of the rotating member proper, with respect to the bearings, etc., have to be taken into account, even though it is placed in a vacuum, as gravity will cause the wheel to exert weight on the points of suspension which would, of course, be the bearings. Disregarding these facts altogether, it can be seen that although it looks quite certain that the balls falling out along the spiral grooves of the wheel at the right will surely tend to exert a greater force "downward" in a turning effort on the wheel than the counteracting "lift" force required to raise the balls as they move backward to the center of the wheel, such is not true.

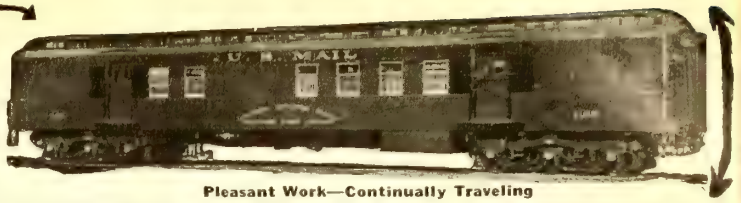
It will be found upon critical inspection of all such wheels that, although some of the weights or balls are more distant from the center of the wheel than others, yet there will always be a proportionately smaller number of them at that part of the wheel on which they exert the greatest power, so that these exactly counterbalance each other and hence the wheel will stand still. Hundreds of similar designs employing liquids, such as water, mercury, etc., bellows, weighted collapsible leaves and what not, have been devised and thought out to bring about the much-desired function of "perpetual motion," but without avail.

Of later years and in view of the marvelous characteristics of radium, for instance, which was supposed at one time to give off energy forever, there have been many pseudo-scientists who, in speaking of perpetual motion, simply mention the word, Radium! as if they had solved the whole question finally and completely. The latest research work on radium has brought out the fact that it eventually loses its power to give forth energy in the form of electrons at the end of about 2,500 years. To some of us no doubt this would seem near enough to the goal of the perpetual motion dreamer, and a radium clock would seem to put any of the devices of this ilk invented in past years away in the shade. A radium clock that undoubtedly will work all right has been devised by Prof. Struts. This may be said, without a doubt, to be one of the nearest ap-

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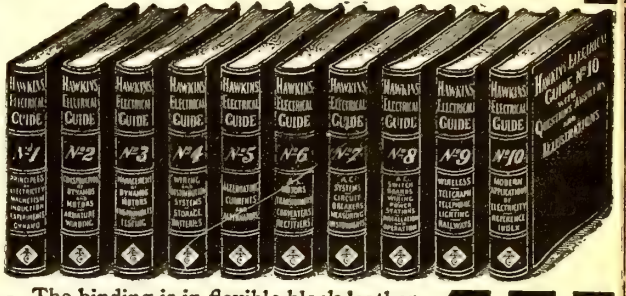
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proaches to a practical perpetual motion device ever invented. It comprises a glass bulb, as perceived in Fig. 7, inclosing a gold leaf electroscope, some radium salts and a metal wire which has one end connected to the earth. The action is as follows: The emanation of the radium in the form of electrons shot forth at high velocity, charges the leaves, which diverge slightly, until one of them touches the wire at A. As this terminal is connected with the ground, it carries off the electrical charge, leaving the gold leaf discharged, but which are then recharged from the electrons continuously given off by the radium. This charge is again carried off to earth, and so on, *ad lib.* No doubt a suitable electrical contact of delicate mechanical construction could be arranged so that every time the leaf touched the wire A it would cause a secondary electrical circuit to operate some electromagnetic device connected to a standard clock mechanism. Also it might be possible to construct a sufficiently sensitive mechanical arrangement inside the bulb, which would be actuated by the movement of the gold leaves as aforementioned.

The life of such a clock would be 2,500 years, if our present knowledge of radium and its characteristics are correct. Thus we see that, in so far as practical results, or in fact any results worth mentioning are concerned, the problem of perpetual motion is practically as far from solution as it ever was since the dawn of creation.

Wherever you find practical engineers and scientists at work in the laboratory or in the field, you will always find some practical form of energy being utilized, either from waterfalls, some form of gas or coal, mineral oils or windmills, etc. There are a number of mighty forces as yet unharnessed in nature, which so far have baffled the many master minds trying to solve their mysteries; notable among these there is the almost unbelievable force available in the ocean waves, which perpetually wash our shores; the energy in the sun's rays, which has been used practically in some apparatus devised in the past few years, but not to any extent worth mentioning; the efficient use of wind energy, and the direct generation of power from coal, which at present entails 90 to 98 per cent. loss in boilers, engines and piping. But let the perpetual motion specialists dream on, for he who never dreams never accomplishes, someone has said.

TWO NEW WIRELESS DETECTORS.

(*Continued from page* 485.)

a couple of seconds. The mineral, *lenzite,* employed in same is probably one of the most interesting features of this particular piece of apparatus. It is said to be one of the very best materials ever discovered for the purpose in question. Lenzite is a composite substance, made up from a number of different metals, and the secret of the composition is known only to the sponsors of the instrument. It sells at a nominal price and makes a very businesslike appearance in any radio station. The manufacturers claim to have had this detector tested by Government and other bona fide radio stations with very successful results. Fiber thumbscrews enable the mineral cup within the glass, dust-protecting tube to be moved as required. The "cat-whisker" wire at the right is controlled by a substantial thumbscrew, as perceived. This is held in a bushing surrounded by a soft rubber gasket to overcome vibrations, which, of course, always tend to easily knock such detectors as these out of adjustment. The terminals are of substantial pattern, as ob-

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THE REGENERATING AUDION CIRCUITS FOR WIRELESS RECEIVING.

(*Continued from page* 488.)

Referring again to Fig. ., transformer T, condensers C^3 and C^2, may be eliminated and the simplified Armstrong circuits connected together at junction point O, Fig. 2. Transformer T (in Fig. 1) may be compensated for by increasing the telephone inductance. This may be accomplished by using telephones in the neighborhood of 3,000 or 4,000 ohms; although telephones of 1,000 or 2,000 ohms may be used, it is advisable to use the higher ohmage, with its corresponding higher inductance. This somewhat simplifies the arrangement, giving practically the same results. After the apparatus are all connected up the following instructions should be followed in adjusting the instruments to any given station.

Set condenser C^5 at its maximum capacity, inductance coil L^1 at zero, and tune the primary inductances and inductance coil L, condenser C and grid condenser C^1 until the incoming signal is at a maximum, then increase inductance coil L^1 (which will increase the signal strength many times) until the audion is below the point of generating. Finally decrease condenser C^5, keeping the audion below the point of generation until the maximum strength of signals are realized. This indicates that the limit of amplification is reached, and beyond this it is impossible to go. When connecting the secondary terminals to the grid coil and junction point O, a trial should be made to determine which side of the secondary connects to the junction point O, as it makes a slight difference in tuning.

A simple test to determine whether the audion is oscillating is to *touch the grid connection* (where it leaves the audion) *with the finger.* If a sharp click is heard in the telephones the circuits are oscillating. This condition is necessary in order to receive the "undamped waves," utilizing the "beat" principle.

All connections should be of stranded wire. While the dimensions given are for the longer wave lengths, apparatus may be constructed for wave lengths of 200 meters and up by simply making the wing and grid coils L and L^1 much smaller with finer graduations of inductance. In this case the loose coupler will obviously require taps or sliders, using No. 24 wire on the primary of the coupler. The rest of the apparatus remains the same. This type of apparatus and connections are well worth constructing and using, as it constitutes the most advanced means known at the present time in the reception of both damped and undamped radio signals.

ELECTRICAL SEWING MACHINE MOTOR STAYS WHERE YOU PUT IT.

(*Continued from page* 484.)

ter of gravity of the whole motor and pedestal is so balanced out that when the friction pulley of the motor shaft is placed underneath the hand-wheel of the sewing machine, it will drive it without the motor tilting upward at the back, as might be suspected on first sight. The motor comes with plug and flexible cord so that it may be attached to any convenient lamp socket. It is furnished wound for any commercial voltage or frequency. The manufacturers of this unique motor drive for the sewing machine claim that it performs its duty all day without getting out of alignment, and it should indeed prove a boon to those who have any extended use for such a labor-saving device.



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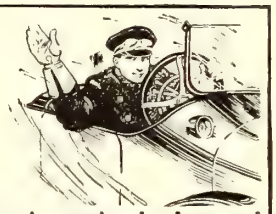
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THE POINATOWSKI RAY.

(*Continued from page 473.*)

approaching from Zapata came a chance shell among Rutherford's men, and exploding, wrecked the projector, put Captain Cawthorne to the ground and killed three others. Kilroth sprang to his Captain, slipped his arm under his head and asked: "Where are you hurt, Captain?"

"Leg smashed again," grinned Cawthorne. "Get me the other if you can, Kilroth!"

Kilroth glanced at the debris of shattered poplar and steel wire which had been his Captain's false leg, and with a muttered "Thank God!" dashed away to the supply auto, where a substitute had been carried. As he came back Cawthorne was sitting up gazing ruefully at the wrecked projector.

"It all depends on the Admiral now, Kilroth. We're out of the game, except for the Nullifiers. They can probably protect us in our retreat to the Rio Grande."

"Hard luck!" grunted Kilroth. "They should have let us have both projectors. Four hundred troopers with only one effective weapon sent out againt 20,000 of the enemy—not counting their fleet."

The Colonel came up, glanced at Cawthorne adjusting the fastenings of his false leg, and exclaimed: "I didn't expect to see you able to move. It's fortunate for all of us that you were not injured."

Cawthorne shrugged his shoulders. "The only possible use I have been to your command, Colonel, is smashed out of commission—almost out of recognition." He pointed to the wrecked projector and added: "I suppose that means that we draw out of the game now?"

"Only as far as that cañon!" asserted the Colonel grimly. "We must have cover from the battleships' guns. They're getting into action now, and when they get our range we must be behind rocks."

He gave the command: "Leave those big guns and retreat instantly to that cañon! Signal Nullifier No. 3 to draw back here. We must not risk both those machines at the same time. Order Nullifier No. 4 to continue operating over the enemy's trenches."

Then to the wireless operator he ordered: "Call up Admiral Roberts' flagship and report that our projector is wrecked. Tell him that we will hold our position here, and if he succeeds in exploding the mines and coming up into the bay to engage the enemy's fleet, we'll keep our Nullifiers in action on the land enemy at Zapata."

And a rapid command to Cawthorne followed: "Captain, have the muzzles of those big guns elevated so as to draw any enemy's fire. Also leave that rapid-fire gun among them. Attach the wireless firing mechanism to it, and then draw off every man into the cañon!"

The retreat, or perhaps side-step, was quickly made, and with the rugged, hoary Chapaderas Range between them and the coast, the command, with horses and supply autos, were safe from the fleet guns, the shells from which, however, were directed at the five great wooden counterfeits and the smoke from the rapid-fire, which were clearly visible from the bay across the open mesa.

"That deceives them, all right," laughed the Colonel, "and if we keep quiet here for a while they'll believe that they've wiped us out completely. There go the guns!" as a shell exploded and scattered the images over the plain.

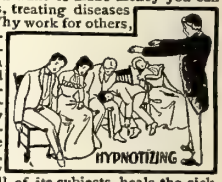
A scout aero was signaled to come down, and as it reached level ground at the mouth of the cañon the wireless officer reported an answer from Admiral Roberts:

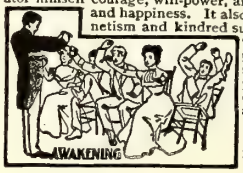
"Our projector has destroyed apparently every mine and several submarines. Am advancing up the bay to

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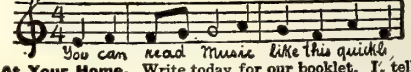
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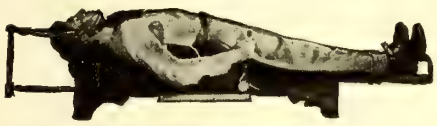
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and ask yourself what it will avail you if you neglect your body? You think the brain is the all important essential in the race for your goal. Is it? Will your brain live longer than your body? Will your brain live up to its training and do good work if it has to be continually flashing messages from a neglected body, or registering protests from a disorganized stomach? Will the brain of a crooked, scrawny, dyspeptic, or weak, puny, undeveloped man justify the training it has had? Or will a brain weakened by youthful indiscretions be 100 per cent. efficient?

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engage the enemy's fleet, and shall then proceed to Zapata to take the land forces. Hold your position until I arrive. It will be safer than retreat."

The Colonel scowled grimly as he handed the paper to Cawthorne. "The Admiral assumes that he gets not only the surrender of the fleet but of the entire land force; and we are to sit here and wait till he comes in to protect us. Fortunately we are not under his orders. Cawthorne, step this way for a few moments."

Ten minutes later the two officers grasped hands, their faces beaming, and Cawthorne strode over to the scout aero, climbed into a seat and went into the air, heading across the great Cisneros Bay. With him were the operator and a wireless man.

They passed directly over the Japo-Chinese fleet—16 battleships, seven of which were the most modern and powerful dreadnoughts ever designed. Every vessel was under steam, and while two had run up close to the Zapata shore in order to meet any further attack from Rutherford's command the other great ships were speeding down the bay toward the point around which Roberts' fleet would have to come.

The aero flew swiftly, and the 18 miles to that point were quickly covered. Beyond it they saw the Stars and Stripes floating from the fleet, which was moving very slowly. One vessel only—a light cruiser—was pushing ahead, and through his glasses Cawthorne saw the big projector tube at the bow. Almost at that moment the cruiser slowed down as her nose poked round the great perpendicular Vaquera Rock, which had obstructed any view of the enemy, and as she reached that position the projector tube was swung over to port, pointing at the approaching Jap battleships, four miles up the bay. With a gasp of delight Cawthorne saw the puffs of smoke from every turret of those vessels, and the next instant the crash of the detonations reached them.

"Firing down the bay with not an enemy in sight except that cruiser!" ejaculated Cawthorne. "And they haven't had time to aim at her. Roberts gave the order for that firing, and the ray—the wonderful Poniatowski Ray—did it!

At the rear of the enemy's battleships were several light-armored cruisers which, as the ray reached them, exploded their magazines.

"Absolutely unnecessary!" growled Cawthorne. "He's using too heavy penetration. I was afraid of that, and warned them against it. If they concentrate much more than they're doing, they'll get through the heaviest armor to the magazines and blow up those dreadnoughts, and our good old country'll lose them all."

But the Admiral must have ordered less penetration, for no more magazine explosions took place. For a few moments the battleships were maneuvered to bring their turret guns to bear upon that one mysterious cruiser in the shadow of the great Vaquera Rock, but before any gun could be aimed or elevated or depressed the ray struck the charge and discharged it. In less than three minutes the firing ceased and the United States battleships were under forced draft, dashing round the point.

Cawthorne howled delightedly to the wireless officer: "Send word to the Colonel that Roberts is steaming up the bay. All firing ceased." Then to the operator: "Work up the bay and over Zapata!"

As they glided over the great horde of tents, supplies, munitions and men Cawthorne waved a white flag until an answering flag showed that he would be received. They glided to the ground, and the Captain was escorted to the Allies' headquarters and received by Ito, the Japanese General, who understood English perfectly.

(*Continued on page* 521.)

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THE PONIATOWSKI RAY.

(*Continued from page* 519.)

Cawthorne stated his mission concisely and very determinately. "Your fleet is silenced, General, by the marvelous ray projector which Admiral Roberts has, a duplicate of which destroyed your aero fleet to-day. The power of tnat ray has not been fully demonstrated to you yet, for if the penetration was increased to capacity it would explode every magazine behind the heaviest armor on the greatest dreadnought out there.

"And if we put our land projector into action again against your camp here, not one grain of explosive will escape. Your entire force will be annihilated! I am ordered by my commanding officer to demand your unconditional surrender!"

An hour later two wireless reports were sent to Washington. One, from Admiral Roberts, was:

"The enemy's fleet has surrendered with every battleship intact and little loss of life. Three of their cruisers destroyed. No loss on our side.

"ED. S. ROBERTS,
"Admiral of the Fleet in Cisneros Bay."

That from Colonel Rutherford was:

"The entire land force of the enemy at Zapata surrendered to this command at 4.45. Our projector destroyed early in the operations, but the Nullifiers completed the attack.

M. J. RUTHERFORD,
"Colonel of the Cisneros Expeditionary Force at Zapata."

ELECTRICAL HELPS FOR AMATEUR PHOTOGRAPHERS.

(*Continued from page* 493.)

thing must be sharp and distinct, is not like taking a snapshot out of doors in bright sunshine.

Before thinking of anything else you should select the "viewpoint" for your picture, whether you are going to use daylight or flashlight. In choosing your point of view you will find that it will help the picture a lot if you can put some very conspicuous instrument about one third of the way from each edge of the picture (that is to say, so that it would occupy the same position as one of the four heavy dots in Fig. 4). If you are to include yourself in the picture your face should occupy this place.

If you are to use daylight you should also observe that you can see, from the same point of view as your lens, the bright side (not the shadow side) of every instrument, without any instrument being in the shadow of another. If you cannot do this, you had better use a flashlight. Also, if, taking the picture by daylight, you find that you have to include a front view (or even 45° view) of a window, you had again better use a flashlight. In this case it would be better to take the picture *at sundown* than at night, as you will then avoid the peculiar effect caused by black windows, which would mar the photograph.

The next thing after choosing your viewpoint, if you are going to use a flashlight, is to choose the "place for the flash." Here again you should follow the same rule as for daylight, the lens should see the bright side of every instrument of any importance, without its being in the shadow of another instrument.

The exposure is the next thing to consider. If you are going to use daylight you should consult an exposure table, which any photographic dealer will give you free of charge or at very small cost. If you use a flashlight you will find that complete directions about exposure come with the magnesium powder or flash sheet. A very good idea in taking a picture of this

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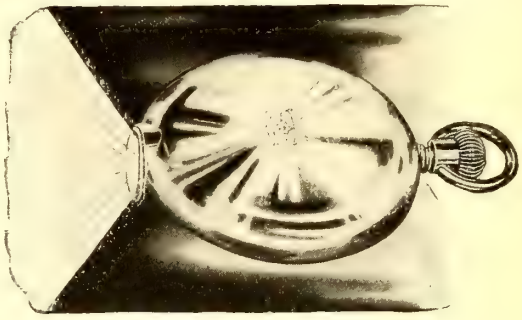
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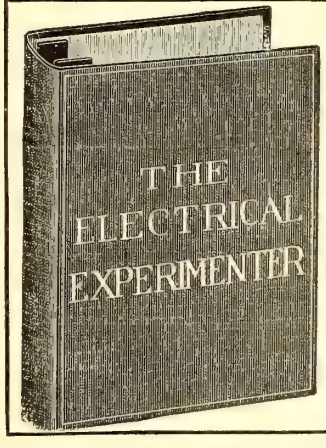
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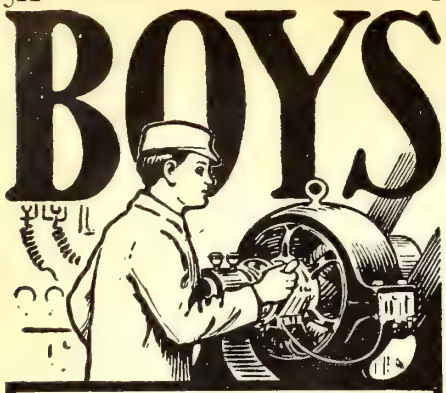


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kind is to expose three negatives, one with the exposure given by your tables or directions; another with one-third of that exposure, and another with three times the exposure. Each of the three negatives should then be developed *separately* (if roll films are used cut them apart). One of them is bound to come out right and give perfect results.

The diaphragm stop used should not be too large, as the instruments at the side of the picture will not be sharp enough. On the other hand, if it is too small, it will considerably lengthen the time of exposure necessary. The best rule to follow is to make it as small as a reasonable time of exposure will permit.

Once the negative is taken the rest, of course, is the same as for ordinary snapshots.

MEASURING THE HEAT FROM DISTANT STARS.

(*Continued from page* 470.)

Using Dr. Coblentz's apparatus at the Lick Observatory, and during the sensitive tests made it was ascertained that the total radiation received from a red star was from two to three times the value of that received from a blue star of the same photometric brightness.

Another interesting problem taken up in this branch of science is the measurement of the radiation from variable stars, especially those which undergo a change of color. The real knowledge, however, will not be gained by measuring the total radiation from stars but by dispersing the starlight and measuring the distribution of energy in its spectrum, and this may be said to be the dream of the experimenter; in other words, the goal toward which he has always turned his efforts. In the near future it is hoped that sufficiently sensitive apparatus of this nature may be constructed which will enable the results aimed at to be achieved. To accomplish this the apparatus must be sufficiently sensitive to measure the radiation of a sperm candle at a distance of more than 500 miles. Dr. Coblentz believes that this can be accomplished without a doubt with some possible changes in the electrical apparatus and also in the reflecting telescope and mirror employed for the purpose.

DOES ELECTRO-MAGNETIC INDUCTION DEPEND UPON LOOPING OR CUTTING OF FLUX.

It was demonstrated by Faraday that when a wire was moved across a magnetic field so as to cut the magnetic flux an electromotive force was induced in the wire during the motion. Faraday also demonstrated that if a loop of wire is linked with magnetic flux any change in the linkage, due either to motion of the loop or to motion of the flux, sets up a temporary electromotive force in the loop. Ever since that time there has been a difference of opinion between electromagneticians as to the manner in which these phenomena should be regarded, says *Electrical World* editorially. Some declared the fundamental law to be that whenever a loop has its flux contents changed in any manner there will be a generation of electromotive force, and the primordial idea is that of a circuit loop. Any cutting of flux by a conductor is therefore a mere case of altering the flux in the loop circuit to which it belongs. Others took the opposite view and contended that a loop is a mere series aggregation of conducting elements, the primordial idea being that of the cutting of flux by some of these elements. It is true that when cutting is effected in this way there will be a change of flux in the circuit, but that is a consequence and not a cause of the electric action. So the loopers and the cutters carried on an animated intellectual warfare, each side declaring that the other side set the cart before the horse. There is a large literature on this peaceful war. In the great mass of engineering dynamo phenomena it was a matter of complete indifference, from a practical point of view, which opinion was held. There was nearly always both a looping action going on, to satisfy the loopers, and also a cutting action going on, to content the cutters. Nevertheless, from an intellectual standpoint, each saw the universe of the other as inside out.

Of recent years, however, the evidence has been accumulating on the side of the cutters. It has been pointed out, for example, that if a loop full of magnetic flux was suddenly injected into a circuit loop, without any flux cutting, and merely by switching at some point of contiguity, no electromotive force was generated in the circuit, and yet flux was being inclosed in a new loop. Blondel recently demonstrated by a series of experiments that when loops are changed in flux contents by tangential motion, as distinguished from motion which cuts, no perceptible electromotive force is generated. This is another blow for the loopers.

Looked at from the standpoint now reached after 70 years of debate, it would appear that no electromotive force can be induced in a circuit unless flux cuts the boundary. "No cuts, no volts," is the day's password. Furthermore, this slogan means, if it is to be trusted, that when a secondary coil lies outside of a primary coil, as, for example, when we apply first a primary and then a secondary winding to a laminated ring core, the flux which traverses the core when the primary winding is energized does not spring up and develop within the primary coil, but comes jumping through the secondary coil from outside, so as to cut the secondary wires. Let us hope that the loopers will finally admit that their loops are cut, and find other fields to occupy their honest and valuable warlike activities.

DR. DE FOREST TELLS OF RADIOPHONE TESTS.

Dr. Lee De Forest, the American wireless engineer, who went to England in September in connection with the trans-Atlantic wireless telephone tests, returned recently from Bordeaux. In an interview regarding trans-Atlantic radio-telephone tests between Arlington and the Eiffel Tower, Dr. De Forest said:

"I was in Paris when for the first time in history words spoken in America were heard across the Atlantic Ocean. I am immensely gratified that it should have been my inventions which first made possible the realization of the prophecy I made seven years ago. At that time I was criticised for announcing that trans-Atlantic wireless telephony would be an accomplished fact within 10 years.

"I found that the French Army officers had been using my audion and amplifier for more than a year, and were particularly pleased at the strength of the telegraph signals they obtain with it from our naval radio station at Darien, Isthmus of Panama.

"The three or four words heard were very faint, but they served at least to accomplish the feat desired by my patent licenses. It marked a genuine epoch. As a matter of fact, it was unnecessary to attempt to use the Eiffel Tower antenna for receiving from Arlington. A connection to some of the network of telephone and telegraph wires to the west of Paris would have answered the purpose."

BARON MÜNCHHAUSEN'S NEW SCIENTIFIC ADVENTURES.

(*Continued from page 474.*)

The Martian, by long training of his brain for generations back, is enabled to "tune" his mind to a comparative wide range of waves, thus with but little effort he can think in a high "pitch" or in a low one. As each pitch has its own characteristics—no two being alike—it becomes easy for anyone to "listen" to the selected one only. It is the same as if you converse with your friend while ten other people talk all at one time in the same room. By instinct you are enabled to listen to your friend's characteristic voice, disregarding all the other voices. You "tune" your ear automatically to his voice, and while the sounds of the ten other voices reach your ear, you do not *consciously* hear them.

Exactly the same is the case when the Martian converses by thought transmission; his brain "hears" only that what he actually wishes to hear and nothing else. Nor can one Martian force his thoughts upon another if the latter does not want to "listen." He simply shuts the other out, just as you can shut out your friend's voice if you do not care to listen to him. You "tune" his voice out by concentrating real hard on a subject, with the result that you are not conscious of what he is talking about. The same is the case with the Martian.

On the other hand, if the Martian does not want to have anyone "listen" to his thoughts he simply pushes the plates away from his temples, when, of course, no thought transmission can take place.

But, as usual, I get ahead of myself. I believe that I told you last night how we had taken an excursion over the mighty Mars canals with our host, the Planet Ruler, and how we had been shown the machines which move the waters in these miraculous canals. After the inspection our host took us back to the executive palace and once more we were seated in our transparent chairs.

Our host also resumed his transparent chair in front of his desk, which, as I mentioned yesterday, was flat and transparent, while on top 20 transparent Tos rods, curved like goose necks, were mounted in two semi-circles. Our host sitting in front of the desk formed the center of one of the semi-circles, in such a manner that one goose neck was as far away from him as the other.

The august ruler hardly sat down when a 10-foot transparent Tos rod which was mounted on the desk suddenly gave out a pleasant but penetrating chime-like sound. Our host immediately assumed an exceedingly grave manner and quickly motioned to us to pay close attention.

We then witnessed a most astounding procedure.

The ruler of the Planet Mars placed his finger upon a black button-like contrivance in front of him and instantly the transparent goose neck Tos rod in front of the button changed its color and became almost milky white. Simultaneously its upper sharp point began to glow in a bluish white color and a faint discharge, not unlike tobacco smoke, struck our host squarely in the face. This discharge was unlike any electrical high tension phenomenon we had ever witnessed, for it was transparent and it did not make the slightest sound. Moreover it seemed to constantly undergo changes; for a few seconds the stream would be bluish white, quickly to change to a pinkish color during the next moment. Then again it would appear slightly violet. One moment it would spread out, the next it would look like a single beam of light. Altogether it was the most singular, astonishing phenomenon we had ever seen.

But this was not the most wonderful part, for when our eyes were directed upon our host's face another surprise awaited. His expression was continually changing; sometimes he would smile, sometimes he would look very severe. At other times he would nod as if he was giving his approval to something; then again he would sway his head slightly from one side to the other, but at all times while we were watching him we could not rid ourselves of the idea that he was "reading" something.

Indeed, as we were to find out later, this was precisely what he was doing. In other words, we were witnessing how *the Ruler of the Planet Mars was "reading" his morning "correspondence!"*

While we were still marveling the goose neck stopped its dicharge—the ruler had read the first "letters."

We were to see immediately how he answered it. He simply touched a red button in front of the black one, which he had just released, and by his demeanor we did not find it difficult to understand that he was transmitting his thoughts pertaining to the "letter" just received to one of his secretaries. He "dictated" for a few minutes and when he had finished he pressed upon the second black button in front of the second goose neck—he was now "reading" his second letter.

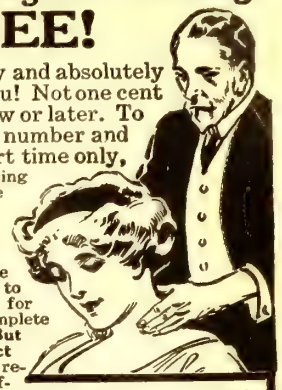
For an hour or more he thus attended to his "correspondence," never slacking, never resting a minute. Whatever the qualities of a Martian ruler are, it is certain that he must be energetic in the utmost, as well as a quick worker. Of course, we had not the slightest inkling of what was going on, but we were to learn the details later.

Briefly they are as follows: The Planet Mars is divided into 10 equal "zones," each administered by a "Zone President." These 10 officials, scattered over the planet at different points, are directly responsible for the welfare of their zone and report to the Planet Ruler once each day at a certain predetermined time.

As the most vital question on Mars is invariably the supply of water, nine-tenths of the Planet Ruler's "correspondence" is on this subject. So strenuous is the battle for existence on Mars that the inhabitants of the planet themselves are always considered after the water supply, never before it. If the Zone President's report has been prepared by him he sits down in front of his desk, similar to the one described, except that it has fewer goose necks than the one of the Ruler. When he presses the red button in front of him his thoughts are immediately transmitted through a cable to the executive capitol and are received by the Planet Ruler. I described a few minutes ago the manner by which the message is received by him. Simultaneously while the Ruler receives his message a record of it is made by one of his secretaries. Connected to the tall Tos rod on the Ruler's desk, which is used to receive the transmitted thought waves, is a sensitive recording mechanism. This latter is in charge of a secretary and works as follows: A thin metallic ribbon of the thickness of tissue paper unrolls slowly in front of a sharp stylus. The thought waves acting upon an amplifying system operate this stylus, which in turn engraves a continuous wave line on the thin metallic ribbon. This wave line is perfectly legible and a Martian can read it as well as you can read an electric ticker tape. Thus incoming as well as outgoing "correspondence" is always recorded, so it can be readily looked up should occasion arise. Each tape is carefully labeled and stored away in the

(*Continued on page 526.*)

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BARON MÜNCHHAUSEN'S NEW SCIENTIFIC ADVENTURES.

(*Continued from page 523.*)

archives of the capital and, being of metal, it will last practically forever.

But I note by my chronometer that the time is up and in a few seconds the telegraphone wire on my radiotomatic on the moon will be full to capacity. So I must cut off short. *Au revoir*, dear boy, and pleasant dreams till to-morrow.....

A snap, a whirring click and the last ether wave from the moon had reached the earth for that night. I lighted my faithful Nargileh once more and gave myself up to a new series of pipe dreams.

(*To be continued.*)

WIRELESS NOW TO TAHITI.

The radio station being built by the French Government on Tahiti Island, Society Islands, will be ready to receive and transmit commercial messages shortly, the United States Bureau of Navigation announces. Communication will be established with stations at San Francisco, in Cochin-China, South America, Honolulu, Sydney and even in Martinique and Guadaloupe, West Indies.

An electric safety razor sharpener has been developed which its inventor claims will re-edge blades as much as 12 times. The blades are clamped in a holder and inserted between two revolving cylinders. The holder moves backward and forward while the cylinders are revolving, and the blades are edged by even pressure applied to both sides.

CAN HEAR VOICE AROUND, WORLD, SAYS PROF. PUPIN.

Now that the human voice has been heard by wireless telephone across a space one-fifth that around the earth it is commercially practicable to hear it all the way around.

Such is the claim made for the invention of Prof. Michael I. Pupin, of Columbia University, which has overcome the static disturbances caused by electrical storms. He said:

"There is nothing now to prevent the transmission of messages by wireless telephone to every part of the globe. We may talk to the antipodes, or, for that matter, send a message completely around the globe if we like."

This discovery is the result of seven years' experimentation in the engineering laboratory at Columbia. Without going into details which might disclose prematurely his patent claims, Professor Pupin said his device is an improvement over the present form of the wireless antennae and makes the apparatus sensitive only to the particular Hertzian waves desired.

WATER ON MARS.

Dr. Percival Lowell asserts that water vapor exists on the planet Mars. Spectrograms taken by Dr. Silphen indicate a difference in the amount of water vapor at different parts of the planet's surface, and Professor Vary, who has been comparing the spectrograms, is satisfied that the source of the moisture is polar precipitation, the equatorial portions of the planet being very dry. The springtime melting at the North Pole produces a considerable amount of vapor.

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WAR orders in every industry we hear are bringing millions of dollars to American factories and American pockets. Prosperity we know is here and apparently here to stay. But—what, say you, have these war orders to do with the electrical experimenter—he is not profiting by them.

He is, and, feeling that he doesn't really appreciate how little he is affected, yet how often he is prone to complain of his lot, I must explain a few things to him and tell him why I think he is lucky.

Firstly: How many articles does the electrical experimenter use that haven't increased in price and often increased heavily as a result of the enormous demands of the whole world for our products, or because they are imported?

Offhand, I can't think of one, so you will probably suggest wood. Even that has gone up slightly, and surely finished wood *has* gone up, following increases in cost of varnishes, shellacs, resins, etc. Yet, the electrical experimenter pays practically the same prices for goods as he did before the war started and in many cases less (with the possible exception of a few sizes and styles of batteries). Of course, it's a natural question for you to ask, if brass, zinc, copper, rubber, everything has gone up in cost, why doesn't the electrical experimenter pay more for his goods. Simply because he buys most of his supplies from reputable concerns that have catalogs widely distributed which contain fixed prices, and they simply have to take that increased cost off their profit, and all too often take a loss rather than raise their prices.

And the manufacturers and supply houses besides increased prices have other troubles, for even at increased prices they cannot get prompt delivery or even reasonable delivery on raw and manufactured materials. I understand that the largest aluminum manufacturer is only taking orders for delivery *eight months later*, while one of the biggest steel companies *won't take an order at all*, and similar conditions exist in the copper, brass, zinc and many other industries. Therefore, friend experimenter, when delivery from a supply house is a bit slower than in the past, try to have a little patience; remember the other fellow's troubles these days that he doesn't pass on to you or tell you about, and be thankful for your lot even tho it may seem a bit hard.

MILTON HYMES.

A recent proclamation of the Governor General of Australia prohibits the importation of electric or magnetic belts.

Scientific Exchange Columns

UNDOUBTEDLY you have at the present time some things for which you have no further use. Do you wish to exchange them for something, for which you have immediate use? There is no surer and quicker way to do this than by advertising your articles in these columns. The **Very** people, the **Only** people, who could possibly have a use for your things read this journal. More than 40,000 interested people will see your ad. It is furthermore the cheapest advertising medium for you in the country. Dealers' advertising accepted in Opportunity Exchange Columns only.

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Subscribers experiencing trouble in dealing with any advertiser should notify the publisher very promptly.

BARGAIN—3-amp. "Amco" hot wire ammeter, 5 inches diameter; slightly used; cost $6. Will sell for $3.50. Eugene Hartnell, Salem, Wis.

FOR TRADE—12 numbers of "World's Advance" Dec. 1914-1915. Want book of "Experimental Wireless Stations" or Electro's universal detector. Forrest Monroe, 1153 Te Walt, Vincennes, Ind.

BARGAIN!! First remittance of $9.50 takes transformer coil with vibrator (½ K.W.) electrolytic interrupter, electrolytic detector and large transmitting condenser. All in good condition. Raymond Guy, Tottenville, S. I., N. Y.

FOR SALE OR EXCHANGE—Modern Electrics, June 1909 to June 1914; Popular Electricity, Dec. 1909 to Nov. 1914; Elect. & Mechanic, Feb. 1910 to Jan. 1912; Wireless Age, first 18 numbers; all inclusive. What have you to "swap"? Leon Bryant, Camden, Me.

HAVE four ½ coils, $1.50 each, Marvel carburetor. Harold Barnum, Knowlesville, N. Y.

WANTED — Small sending and receiving set for $5 gas moving picture machine, generator and film. List of things for stamp. D. MacLean, 334 Stevens, Lowell, Mass.

SWAP—Year 1915 "Telephone Engineer" magazine, value $2, fine condition, for year 1914 "Electrical Experimenter" or good key, or one good 1,000 ohm 'phone; also good telephone magneto for detector, camera for 'phones, dandy 12-inch 3-speed D. C. fan for 'phones, or consider good boxing-gloves bargains. Have large A. C. ammeter for offers; also want audion bulb, "Detectiphone" transmitter, or what? Everybody answered if you write quick. Lloyd Smith, 468 Oak St., Ashland, Ore.

EDISON standard phonograph, New York projecting lantern; each cost $25. Exchange for typewriter, etc. Tillinghast, 63 Wendell St., Providence, R. I.

FOR SALE—Electro $4.50 phones, $2.75; oscillation transformer, $2; high-tension air-cooled spark gap, $1.50. Instruments in excellent condition. Stuart W. Pierson, Carrollton, Ill.

$6 takes induction coupler in hard rubber cabinet, coupling and turns varied by knobs. Want two 43-plate variables. Francis Pray, 102 Heath St., Somerville, Mass.

FOR SALE—Double slide tuner, $1.25; galena detector $.50; Junior fixed condenser, $.40. Whole set, $2. Raymond Horney, Centreville, Md.

FOR SALE—Six telephone magneto generators in good condition, at 75c. each. Can be used as shocking machines, etc. Write Box 360, Lancaster, Pa.

FOR EXCHANGE—Moving picture machine, run by motor. Machine and reels cost $17. In good condition. Will exchange for two 6-volt 60-amp.-hr. storage batteries. Wm. Combs, Water St., Troy, O.

WANTED—A drum. Have all kinds of athletic goods. $50 stamp collection. Write for list. Larest Elwell, 539 Mercantile Bldg., Rochester, N. Y.

FOR SALE OR EXCHANGE—Marconi magnetic detector, cost $10; fixed condenser, receiver ear cushions, ¼-inch spark coil, potentiometer, electrolytic and silicon detectors, mili-ammeter, folding Brownie No. 2 camera. Want variable, or offers. Frank Bremer, 3613 Boulevard, Jersey City, N. J.

NOTICE—110-volt A. C. fan, new condition, $3; 6-volt 10-lb. motor, $2.50; 75-ohm receiver and cord, $.35; Ajax motor, $.50. Sell or exchange for anything of equal value. Electrical, wireless, X-rays, camera, musical, etc. Francis H. Ransford, Dalton, Mass.

FOR EXCHANGE—$15 post card projector, 4x10 Panoram camera, 3x5 Kelsey printing press, $32 B. & L. micro-tessar lens, 72 mm., for 5x8 printing press, binocular or field glass. J. F. Goering, Ames, Kan.

FOR EXCHANGE—Complete wireless outfit, cost $9.25; No. 3 Brownie with portrait attachment, $4.50; Ferron detector, $5; Mesco wireless key, $1.65; Eveready detector, $1.75; fixed condenser, small telescope, spark gap and four-tip cord, $2.60; electrical magazines, $3.50. Everything in fine condition. Want audion, crystaloi, variables, or what? Benj. F. Kinnick, Jr., Greenwood, Ind.

FOR SALE—2x2-inch gasoline engine; has new piston, cylinder, coil and carburetor. The first $15 takes it. Fisher Ames, Massena Springs, N. Y.

FOR SALE OR EXCHANGE—Corbin Duplex coaster brake, $2; carbide bicycle lamp, 75c.; electric bicycle light, $1; boxing gloves, $1.25; waterproof hunting coat, $3; Eastman 3½-inch film developing tank, $3.50. Will exchange for Gernsback rotary variable condenser, interrupter, ½ K. W. transformer coil, or what have you? All letters answered. R. St. John, 609 St. John St., Fairmont, Minn.

FOR SALE—One-inch transmitting set, loose coupled receiving set, including aerial wire, electrose insulators, 100-ampere lightning switch; also 1-7 H. P. motor, medical coil, Brownie 2A camera, tools, etc. Sell to first reasonable offer; all answered. Arthur Reider, 456 E. 10th St., New York City.

HAVE type AA crystaloi. Want good audion bulb or will pay cash for one good or burnt-out. M. Burberry, 627 Germania St., Columbus, O.

RESULTS!

Rosser, Man.

Please make 3 more insertions of my ad. as per enclosed clipping. **Results have more than exceeded my expectations.**

(Signed) J. L. GREEN.

THERE'S A REASON.

WILL SELL good 25-cal. Stevens single-shot rifle for $2.50 or exchange for good 22-cal. single-shot rifle. Ingwald Wick, Hendrum, Minn.

FOR SALE—1½-inch coil, used a short time, for $2.75; also an 80-watt magneto generator for $4.25. Dominick Frank, 111 E. Walnut St., Indianapolis, Ind.

PAIR of steel skates, No. 9½, in good condition. Want pint Leyden jar. Donald Whittier, Readfield Depot, Me.

HAVE good magic lantern and four dozen slides. Will exchange for wireless supplies. Donald Whittier, Readfield Depot, Me.

INGENTO enlarging lantern, cost $55; also set Sheldon salesmanship text books, cost $65. Want printing press and outfit, or what? Daniel Goff, 3159 Indiana Ave., Chicago, Ill.

FOR SALE—Pocket wireless outfit, size of watch. Write for particulars immediately. T. H. Moore, Jr., 321 N. Spring St., Pensacola, Fla.

WILL SELL oak cabinet receiving set, loose coupler (with primary switch) variable condenser, crystal detector, fixed condenser, peroxide of lead detector (new), with new potentiometer and battery, only $10.35; large D. P. S. T. switch on slate base, 55c.; Ajax motor, 90c.; buzzer, 45c. Want burnt or broken audion bulb. Roy Keddy, 35 Josephine Ave., Somerville, Mass.

WANTED—Air guns and rifles. Have football, two cameras, stamp collection $20, electrical and athletic goods. Larrest Elwell, 539 Mercantile Bldg., Rochester, N. Y.

FOR SALE—Wireless instruments, complete receiving set; also key, spark gap and sending condenser. Cheap. Write Walter J. Schneider, R. R. No. 2, Hamilton, O.

FOR SALE OR EXCHANGE—A. C. motor, $2; galvanometer, 75c.; tuning coil, $1.50; ¾-inch spark coil, $1.50; chemistry scale, $1. Write Albert Heyman, 227 S. 20th Ave., Minneapolis, Minn.

WANTED—Camping and bicycle materials for wireless apparatus, or will sell. Arthur Sacha, 2669 E. 40th St., Cleveland, O.

FOR SALE—Cornet, fife, books and some cowboy and wireless goods. Send for list of articles. Frank Saunders, Richmond, Me.

FOR SALE OR EXCHANGE—Nearly new 4 H. P. Indian cycle motor, with carburetor, muffler, friction clutch, pulley and Bosch magneto. Condition perfect, used three months, $30 C. O. D. W. J. Wilson, 2613 Binney St., Omaha, Neb.

FOR SALE OR EXCHANGE—Complete E. I. Co. Tesla coil, including 2-inch spark coil, gap, condensers, Geissler tubes, cost $20; $35 course in elocution, course in hypnotism, how to enter vaudeville, and electrical books. What have you? All letters answered. William Morris, 130 Elizabeth St., Moberly, Mo.

WILL PAY cash for used or burnt-out audion bulb. Four thousand feet of motion picture film given if desired, or iron scroll work machine, cost new $8. Harry Smejkal, 1349 First Ave., New York City.

WANTED—To buy telephone desk set, any standard make, first-class condition, without ringer. Also want separate long-distance telephone transmitter. Donald Palmeter, Roundup, Mont.

WANTED—Constant speed spring motor that will run at least 30 minutes, power stronger than phonograph motor; also unused audion bulb. Fair prices will be paid for these articles if in good condition. William H. Trippe, Toms River, N. J.

EXCHANGE—New radioson detector as part payment on R. J. '4 audion in perfect condition, or will buy. Write Carl A. Mathiasen, Onawa, Ia.

FOR SALE OR EXCHANGE—One ohm-meter for measuring resistance; has range one-tenth to one hundred thousand ohms. Just the thing for wireless experimenters. Cost $30. Will make a good swap. Also two fan motors—A. C.—two volt ammeters for storage batteries. Want a good barometer, hygrometer, or what have you? H. H. Peebles, 1371 Westlake Ave., Cleveland, O.

EXCHANGE—Premoette Jr. No. 1, with outfit. Want small dynamo-motor. Also want water motor cheap for cash. Charles Clapp, Uphams Corners, Mass.

FOR SALE—Complete wireless outfit, mounted and connected on base. Receives Arlington, Va., and Sayville. Sends 10 miles, $30. Send stamp for details. Make fine Xmas present. Charles Palmer, 57 Wollaston Ave., Arlington Hts., Mass.

FOR SALE—Indian twin, '14 model, in fine running condition. Will sell for $125. Louis Germains, 257 Pleasant St., Worcester, Mass.

MERKEL single motorcycle to exchange for long-distance receiving set and small sending set, complete with aerial, or will sell for $19 cash. C. D. Wright, Hamburg, Ia.

FOR SALE OR EXCHANGE—Moving picture machine with oil lamp, film, slides, cost $4, sell for $2. One thousand shot air rifle, cost $1.50, sell for $1, with shot, carrying cover. All in perfect condition. What have you electrical? E. Feddersen, 235 W. 12th St., New York.

FOR SALE—Receiving set, cabinet type, combining receiving transformer, audion detector etc.; also audion amplifier. Other apparatus. Particulars on request. J. A. Crowdus, 5047 Washington Ave., St. Louis, Mo.

WILL EXCHANGE a good motorcycle in first-class running order, free engine clutch, fully equipped, for a four-cylinder gasoline engine in good running condition. R. A. Peschman, Box 3, Ft. Sheridan, Ill.

MOTOR BARGAIN—Kimble ⅛ H. P., 110-volt A. C., six speeds, just rewound and in good condition, $15. Might trade. Ross Gunn, 369 W. Lorain St., Oberlin, O.

FOR SALE—A Baker electric coupe in first-class condition with new batteries; three passenger. On account of illness of owner, will sell at bargain price of $500; cost new, $3,200. S. Gernsback, 817 West End Ave., New York City.

AMATEURS, LOOK—A complete sending and receiving set for sale. All instruments in very good condition, and will fully guarantee them. Will be sold by the piece or complete set. Write before it is too late. Roy Wienn, 522 Wabash St., Michigan City, Ind.

WE HAVE many things to exchange. What have you? Write for list. J. M. Willoughby & Co., Ahoskie, N. C.

FOR SALE—Elec. inst. and books. Write for price list. E. W. Sanor, 198 15th St., Milwaukee, Wis.

I WILL dispose of all my wireless instruments very reasonably. Send for photo and information. E. B. Nassinheimer, 145 W. Fourth St., Cincinnati, O.

FOR SALE—New E. I. Co. $7.50 loose coupler, $5 cash. Freddie Silsbe, Prattsburgh, N. Y.

FOR SALE OR EXCHANGE—Edison phonograph, Model A, combination type, for $10; cost $25.75. Also 22-caliber rifle, Stephen's Favorite, $3; or exchange for nickel-plating outfit. Address Earle Cochran, Poplar Bluffs, Mo., Route 2.

WILL EXCHANGE post card projector, worth $5, for variable condenser either Gernsback, Murdock, Blitzen or Amco. Address Max Clinch, Lakewood, N. J.

WANTED to exchange photo cameras and goods for wireless set; also want dynamo and gas engine. A. B. Warfel, Photographer, Cadiz, O.

FOR SALE—I. C. S. Reference Library Electric Lighting and Railway Course, five volumes, complete, A1 condition. Robert Onstott, care Y. M. Sing, R. 1, Sheldon, Ia.

WILL EXCHANGE 3-inch spark coil for $6 type crystaloi detector. Those interested write. Will Gasper, N. Third St., Marquette, Mich.

FOR SALE—One type AA crystaloi detector, roller and ice skates, two baseball gloves, fish pole, Popular Mechanics (30 old ones), boys' books, Baldwin camp lamp and carbide. Wanted, old, broken or new audion bulbs. Will exchange bulbs for equal value of articles for sale. Write for prices. George Auten, Oberlin, O.

TWO complete sets of wireless receiving instruments sell at half price. For particulars write to Fred Carlotte, 80 Charles St., New York City.

DE FOREST audion detector type R. J. 4 (with X grade bulb), $12. Write for particulars. Francis Blewer, Newark Valley, N. Y.

STOP! Have navy type transformer (switch points), imitation rubber, rotary variable condenser, drafting inst. (12 piece) and 110-volt A. C. motor, 1/6 H.P. Want Crystaloi, electro loading and a single shot 22 rifle. W. O. Fitchett, Waverly, Va.

Carrollton, Illinois,
Nov. 25th, 1915.

Dear Sirs:

I put an ad. in the Scientific Exchange Columns recently, having five instruments for sale. I sold every one of them. ADS IN THESE COLUMNS CERTAINLY BRING RESULTS.

Yours truly,
S. W. Pierson.

FOR SALE—Storage battery plates, six pairs 3¼x5, new. O. Brinnel, 523 First Ave., New York.

FOR SALE—Brand new Murdock 2,400 ohm headset, never used, $4.50; new brass key, ½-inch contacts, $2; smaller key, 50c.; small gap, 40c.; coronet headband, 35c. Clinton Stanley, 153 Mariner St., Buffalo, N. Y.

SALE OR TRADE—1 Murdock rotary gap, 1 1/10 gap motor, 1 navy type loose coupler, $23 kind, will take $13; 4 variable condensers, 3 pr. 'phones, 1 Blitzen 1 K.W. transformer, 1 aerial switch, detectors, insulators, wire 1 motor generator 6-6, 1 jeweler's lathe used 3 months, worth $15, will sell for $9; 1 1-inch spark coil, 1 pr. aluminum roller skates, kodak, and complete outfit; $10 commercial key, new, for $6. All letters answered. Don I. Shepherd, 316 N. West, St. John, Kan.

FOR SALE—Complete portable wireless sets, 2-inch spark coil, sending condenser, spark gap, key, battery and aerial switches, loose coupler, rotary and variable fixed condensers, mineral detectors, loose coil; sacrifice, $25. Fifty ohms learners' set, with battery, $1.50; combination safe, $3; medical coil, 75c. A. Sterling, 78 Third Ave., Brooklyn, N. Y.

FOR SALE—Loose coupler, $1.25; Gem receiving set, $1.25; both Nichols make. In good condition; nearly new. William F. McCarter, 4718 N. Camac St., Philadelphia, Pa.

WANT good 2-inch coil, cheap. For sale, 1-inch Manhattan coil and other wireless goods. Write William F. McCarter, 4718 N. Camac St., Philadelphia, Pa.

WANTED—Wireless goods, battery motor, electrical books, magazines. Have $30 bicycle, 4x5 Seneca camera, 20-ohm sounder, pole climbers. All communications answered. Greer Peck, Springfield, Tenn.

HAVE E. I. Co Junior loose coupler, potentiometer, fixed condenser, electrolytic detector with 2-inch wire. Value of all $8; sell $5. Paul Ramsdell, Calais, Me.

FOR SALE—Navy type loose coupler, 6,000 meter—30 inches long—with dead-end switch, $9; 1 K. W. transformer, unmounted, $9; ¼ K. W. transformer, unmounted, $5. Paul Flehr, Ironton, O.

FOR SALE OR EXCHANGE—Brownie No. 2 camera, $1; detector, 25c.; $2 tuning coil, $1; or will exchange for a ½-inch spark coil. Henry Ananiantz, 700 W. Washington, Los Angeles, Cal.

FOR SALE AT A BARGAIN—A Meccano outfit No. 5 for $9, cost $18. I will trade for some wireless apparatus. Particular sending. Would prefer someone in my own city. Write and get particulars. Alfred Emmerton, 2242 Polk St., San Francisco, Cal.

FOR EXCHANGE—Good $10 Eastman folding Kodak, good as new, for good head phones or good loose coupler. What have you? Dean Wight, Lamoni, Ia.

FOR EXCHANGE—One Gasoline engine, 3 horsepower, A1 condition, for wireless receiving instruments; make me an offer. A. Rush, 323 Traymore Ave., Pittsburgh, Pa.

AUDION detector and 2-step amplifier combination. Best cash offer takes it. Be quick and write for particulars. This is the chance of your life. Have ½ K.W. transmitter at same terms. Louis Gebhard, 1127 Ellicott St., Buffalo, N. Y.

Opportunity Exchange

YOU will probably find more opportunities and real bargains in these columns than anywhere else in the country. Most good things in life are hard to find and worth going after—these little ads illustrate that point; you alone will be the real loser if you don't take the time to scan through these columns.

Advertisements in this section 4c. a word for each insertion. Count 7 words per line.

Name and address must be included at the above rate. Cash should accompany all classified advertisements unless placed by an accredited advertising agency.

Ten per cent. discount for 6 issues, 20 per cent. discount for 12 issues from above rate. Objectionable or misleading advertisements not accepted.

Advertisements for the February issue should reach us not later than January 5th.

EXPERIMENTER PUBLISHING CO., INC., 233 Fulton Street, New York, N. Y.

BOOKS

HAVE YOU SEEN A COPY? Amateur Photographer's Weekly, $1 per year; weekly prize competitions; criticisms; print exchange; illustrated; many features. Three months' subscription, 25c. Amateur Photographer's Weekly, 915 Schofield Bldg., Cleveland, O.

FORMULAS

FORMULAS — Artificial gold, perfume, candies, inks, and 200 others; 3 for 25c. L. Gilbert, Bristol, N. Y.

25c. BRINGS 30 guaranteed formulas, with complete instructions. Includes silvering mirrors, champagne cider, artificial coal, China cement, etc. Daley-Meyer, 688 President St., Brooklyn, N. Y.

HELP WANTED

BOYS WANTED—To buy full-sized paper patterns for Go-Devil bob sled (latest out). Price 30c., prepaid. A. Seaver, Grand Rapids, Mich.

DRAWINGS made for inventors. Consulting Engineer, EE-3240 Seminary Ave., Chicago.

YOUR IDEAS may bring you wealth, if patented through credit system. Send sketch. Free search. Book free. Waters & Co., 4287 Warder Bldg., Washington, D. C.

MISCELLANEOUS

FILMS developed free. Send negative for sample print and particulars. New Lex Novelty Co., New Lexington, O.

THERE is but one Telegraph School that places all graduates direct in the railway telegraph service. It is Pelnars, Madison, Wis.

PATENT ATTORNEYS

PATENTS SECURED through credit system. Free search. Send sketch. Book and advice free. Waters & Co., 4287 Warder Bldg., Washington, D. C.

IDEAS WANTED—Manufacturers are writing for patents procured through me. Three books which list hundreds of inventions wanted sent free. I help you market your invention. Advice free. R. B. Owen, 130 Owen Bldg., Washington, D. C.

PATENTS without advance attorney's fees. Not due until patent allowed. Send sketch for free report. Books free. Frank Fuller, Washington, D. C.

PATENTS SECURED or fee returned. Send sketch or model for free search and report. Latest complete patent book free. George P. Kimmel, 254 Barrister Bldg., Washington, D. C.

STAMPS AND COINS

STAMPS—100, all different, free. Postage, 2c. Mention paper. Quaker Stamp Co., Toledo, O.

$2 to $500 EACH paid for hundreds of coins dated before 1910. Send 10c. for our New Illustrated Coin Value Book, 4x7. Showing guaranteed prices. Get posted at once. Clarke Coin Co., Box 14, Le Roy, N. Y.

WIRELESS

SILICON, 10c. ounce; 35c. half pound, postpaid. Lloyd Gress, Pitman, N. J.

SELLING OUT—Our entire stock of $8 loose couplers at $4.25. One of these same instruments in test received 1,600 miles. Manuel Rattner & Bro., main office, 36-38 Union St., Poughkeepsie, N. Y.

RADIO queries answered fully and promptly; 3 for 10c.; 8 for 25c.. J. L. Green, Radio Information Bureau, Rosser, Man.

GALENA Detector No. 35, on fiber base, 35c.; parts, 25c.; postage either, 5c. Cat whiskers, 3 for 5c.; 12 for 15c., mailed. W. Patch Co., Klemme, Ia.

WIRELESS—Bargains in new wireless goods, circulars for stamp. Imperial Electric Co., 89 Wallabout St., Brooklyn, N. Y.

$10 COMMERCIAL Keys for $4. Money refunded if not satisfied. Massie Wireless Telegraph Co., 77 Washington St., Providence, R. I.

2,500-METER loose couplers, $5; other wireless bargains. Send for circulars. Cliff Mfg. Co., Brookfield, Mass.



WITH REGULAR BAND

Complete Double Set

2000 Ohms - - $4.00
3000 Ohms - - 5.00

With Coronet Band
$ .50 additional



WITH CORONET BAND

WHAT YOU SAVE

on these remarkably good 'phones will buy other Murdock apparatus for your station. REMEMBER, these low prices do not mean cheapness in the goods. These No. 55 receivers are real wireless 'phones, with pure copper wire coil windings—with resistance guaranteed. They are far superior to any you may obtain elsewhere—in sensitiveness, in materials, in construction. They bring in the signals from far and near with the sensitive precision of more expensive instruments. They work well, look well, and wear well.

MAKE A TEST YOURSELF

We will, upon receipt of price, forward the set desired for fourteen days' trial. If they are unsatisfactory in any way, they may be returned and your money will be refunded immediately.

Prompt shipment is part of the Murdock policy of service to customers. This should be appreciated in holiday-rush times.

Our catalog is free. Ask for it.

WM. J. MURDOCK CO.

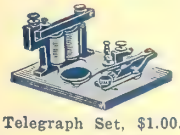
55 Carter Street **Chelsea, Mass.**

680 Howard Street, San Francisco

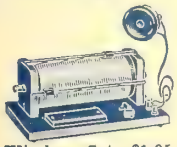
WE ARE HEADQUARTERS FOR ELECTRICAL AND WIRELESS GOODS



Flashlight, 60c.
(22 other styles.)



Telegraph Set, $1.00.



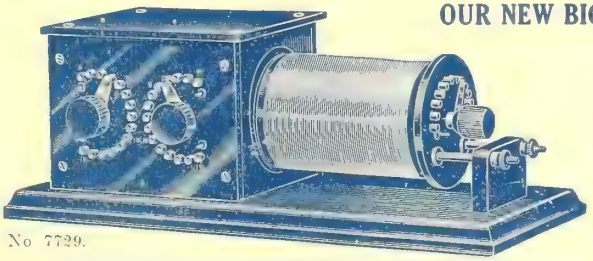
Wireless Set, $1.95.
We set the standard in complete receiving and transmitting outfits. Don't buy until you see our Catalog.



Bicycle Light, $1.75.



Crystal Detector, $2.25.
15 other styles from 30c. up



No. 7729.

THE AMCO NAVY TYPE RECEIVING TRANSFORMER

Represents the latest advances made towards the ideal tuner and embodies the greatest degree of perfection yet obtained. No greater value can be secured where accurate selectivity, sensitiveness and finish are desirable. The illustration shown herewith cannot possibly do justice to the instrument itself. The primary winding is enclosed in a cabinet, the sides and top of which are polished hard rubber. Two 15-point switches are mounted on the front. One switch controls the primary in groups of several turns and the other controls one turn at a time. The entire variation of the primary is thus secured by the rotary motion of two knurled knobs rather than the movement of a slider, and may be varied from **1 to 225 turns in steps of one turn at a time.** The windings are especially adapted to long wave lengths. The secondary is wound with green silk covered wire. The ends are HARD RUBBER, turned and polished. Secondary variation is secured by a 12-point switch which makes it possible to secure a very fine adjustment. **PRICE. ONLY $15.00**

SEND 6 CENTS FOR OUR CATALOG. DO IT TODAY. YOU NEED IT.

IF YOU ARE BUILDING SOMETHING, WE HAVE JUST WHAT YOU HAVE BEEN LOOKING FOR

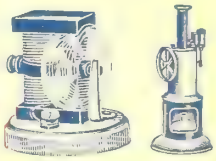
Our No. 6 CATALOG shows several hundred parts and sets of materials for building your own apparatus at home which have never before been listed. We do all the difficult work in our factory and then you put them together.

Complete description and prices of the latest Electrical and Experimental Apparatus—Storage Batteries, Rectifiers, Transformers, Induction Coils, Wireless Apparatus, Lamps, Flashlights, Meters, X-Rays, Books, Tools, Electric Railways, Steam Engines, Water Motors, Dynamos, Motors, Telegraphs, Telephones, Electrical Supplies, Model Aeroplanes and Parts for building your own apparatus. A Treatise on Wireless Telegraphy, telling how to put up an aerial, connect apparatus, together with a Call list and Wiring Diagram, FREE with every catalog. 6c. in stamps will bring you this wonderful book. The best catalog of wireless apparatus, etc., published.

ADAMS-MORGAN CO. [The Experimenters Supply House] **13 Alvin Place, Upper Montclair, N. J.**

OUR NEW BIG 216 PP. ELECTRICAL AND WIRELESS CATALOG

IS THE EXPERIMENTER'S REFERENCE BOOK.



Electric Motor, 50c.
Our Catalog shows 25 more.

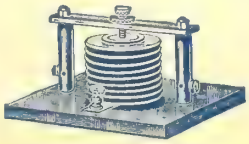
Steam Engine, 50c.
18 others & big gain prices in our Catalog



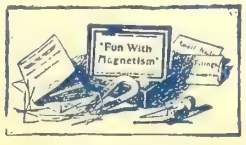
Spark Coil.
Amco Spark Coils are acknowledged the best.



Light Outfit, 75c.
Several hundred miniature lamps, sockets, etc., are illustrated in our Catalog.



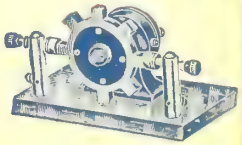
Quenched Gap, $15.00.



Fun With Magnetism.



Fun With Electricity, 50c.



Rotary Gap, $12.00.

You benefit by mentioning "The Electrical Experimenter" when writing to advertisers

Christmas Gift Suggestions

ELECTRIC LIGHTING OUTFITS FOR CHRISTMAS TREES

For the Christmas tree, the house party table, and at all other night-time gatherings—either indoors or out—our lighting sets may be tastefully worked into the decorations. They are safe, easily installed and will last for years.

We especially recommend these outfits for Christmas tree lighting as shown in our illustrations. There is hardly a thing that is more welcomed by the little ones as well as grown-ups than an electric lighted-up Christmas tree. People who have never seen these outfits in actual use cannot appreciate the beauty that can be obtained by colored electric lights. The wiring as well as the sockets that hold the lamps are in green to match the color of the tree itself, and for that reason only the lights themselves show up to their full advantage.

Any one even with no experience at all can place these lights on the tree and it is of course self-understood that the larger the tree the more lights should be used.



BATTERY OUTFITS

In localities or houses which do not have lighting current we recommend our battery outfits which work from 15 to 20 hours figuring 3 hours' steady use each day. Of course if the current is turned on for a shorter period of time the batteries will last much longer.

BATTERY OUTFIT PRICES

No. 5700 Electric Tree lighting outfit, with 8 lights and 3 batteries. Size of box without batteries 6¾x5¾x2 ins. Shipping weight 12 lbs. **$2.35**

No. 5701 The same outfit without batteries. **$1.85**
Shipping weight 2 lbs

No. 5702 Electric Tree lighting outfit with 8 lights and 6 batteries. Size of box without batteries 6¾x5¾x2 ins. Shipping weight 20 lbs **$2.80**

No. 5703 Electric Tree lighting outfit with 16 lights, 6 batteries. Shipping weight 25 lbs. **$4.40**

No. 5704 The same outfit without batteries. Size of box without batteries 6¾x5¾x2 ins. Shipping weight 3 lbs **$3.60**

110 VOLT LIGHTING OUTFITS

These outfits do not use any batteries but each festoon is equipped with patent attachment plug which screws into any 110 volt electric light socket. There is no danger to this outfit either from fire or from shock. These outfits have all been approved by the National Board of Fire Underwriters.

The lamps themselves have an average life of 800 hours. The lamps are quite powerful, having 14 volts and will give a strong light, even 1 festoon will light up a small tree quite brilliantly.

Each outfit has an assortment of the following colored lamps Red, green, blue, frosted, clear.

LIGHTING CURRENT OUTFIT PRICES

No. 5706 1 festoon, 8 lamps 14 volts. **$1.95**
Size 10x4½x2½ inches. Shipping weight 2 lbs.

No. 5707 2 festoon, 16 lamps 14 volts. **$4.05**
Size 13½x5½x2½ inches. Shipping weight 3 lbs.

No. 5708 3 festoon, 24 lamps 14 volts. **$5.85**
Size 14x6½x3 inches. Shipping weight 4 lbs.

No. 5709 4 festoon, 32 lamps 14 volts. **$6.90**
Size 15x8x3 inches. Shipping weight 5 lbs.

NOTE.—These outfits work on either direct or alternating current. If they are to be worked with 220 volts, get our special prices on resistance and state how many festoons you wish to use.

No. 255. ELECTRICITY AT HIGH PRESSURES AND FREQUENCIES



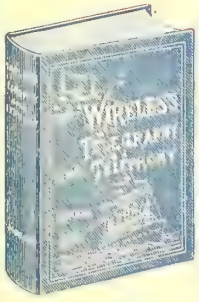
No. 255

By Henry L. Transtrom. Only a few years ago a potential of 2,000 volts was considered unusually high, but at the present time we are using pressures as high as 60,000 volts, while that of 110,000 volts is not uncommon.

This work is a practical treatise of some of the wonders of high-frequency currents at high and other potentials, and should be in the hands of every electrician and engineer who desires to keep abreast of the times. **One of the most wonderful books ever written.**

Handsomely bound in cloth; printed in large type on good paper and profusely illustrated. Size 5 1-4x7 1-2 in.; with 141 illustrations and 247 pages. **Price,** sent prepaid, **$2.00.**

No 283. WIRELESS TELEGRAPHY AND TELEPHONY SIMPLY EXPLAINED



No. 283

By Alfred P. Morgan. This is undoubtedly one of the most complete and comprehensible treatises on the subject ever published. A close study of its pages will enable one to master all the details of the wireless transmission of messages. The author has filled a long felt want and has succeeded in furnishing a lucid, comprehensible explanation in simple language of the theory and practice of wireless telegraphy and telephony. Cloth bound, 154 pages, 156 engravings. Size 7x5¼ in. Price, sent prepaid **$1.00**

No. 761. PRACTICAL ARMATURE AND MAGNET WINDING



No. 761

By Henry C. Horstmann and Victor H. Tousley. Treats in a practical and concise manner a very important subject. All armature winding and design of same are fully explained. In pocket size; bound in full Persian morocco leather, with round corners and red edges; contains 255 pages and 128 illustrations; also useful tables. Size 4¼x6¾ in. **Price, $1.50,** sent prepaid.

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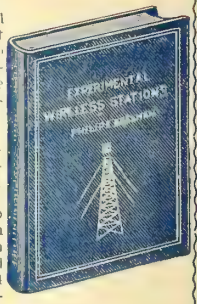
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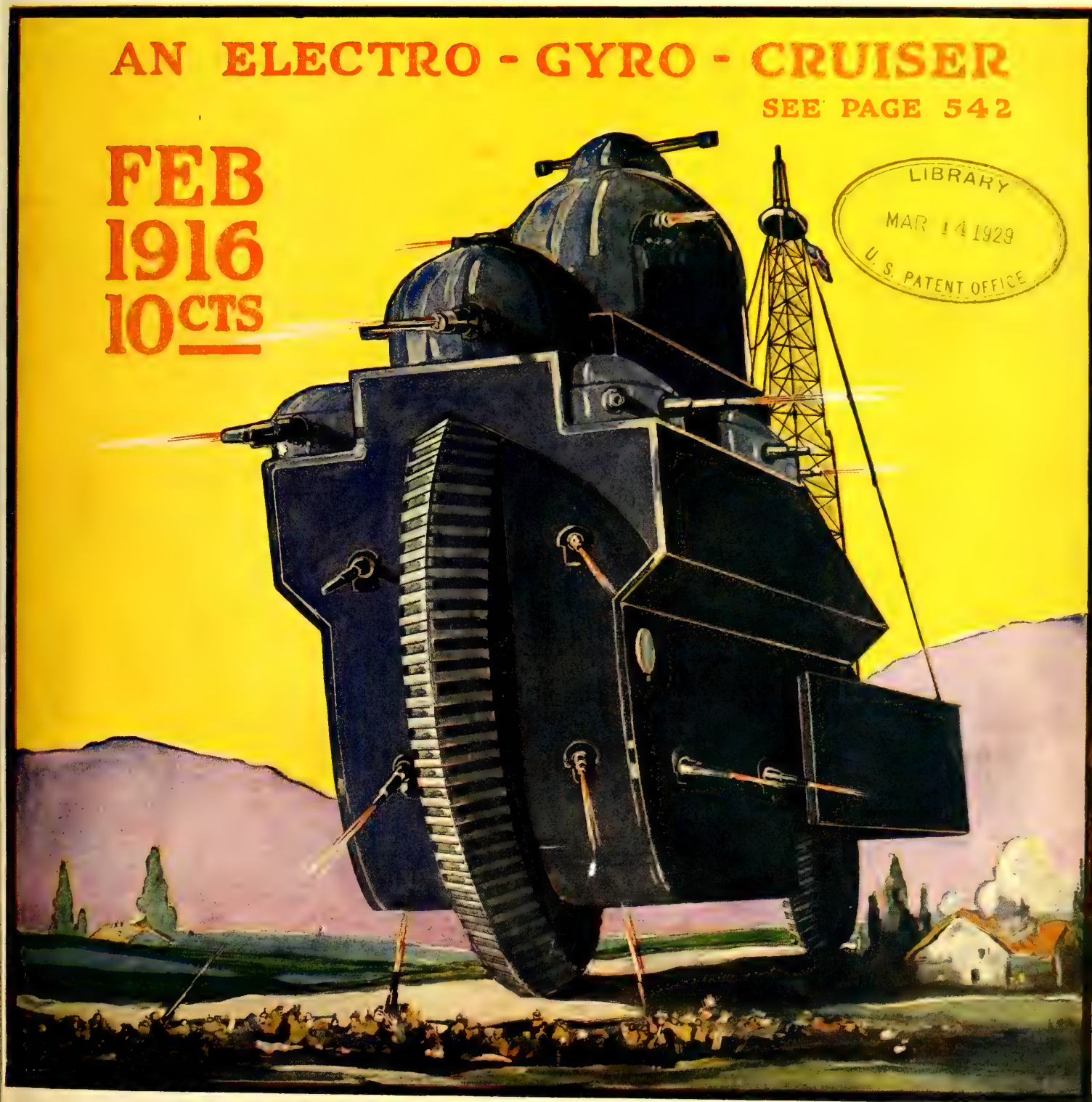
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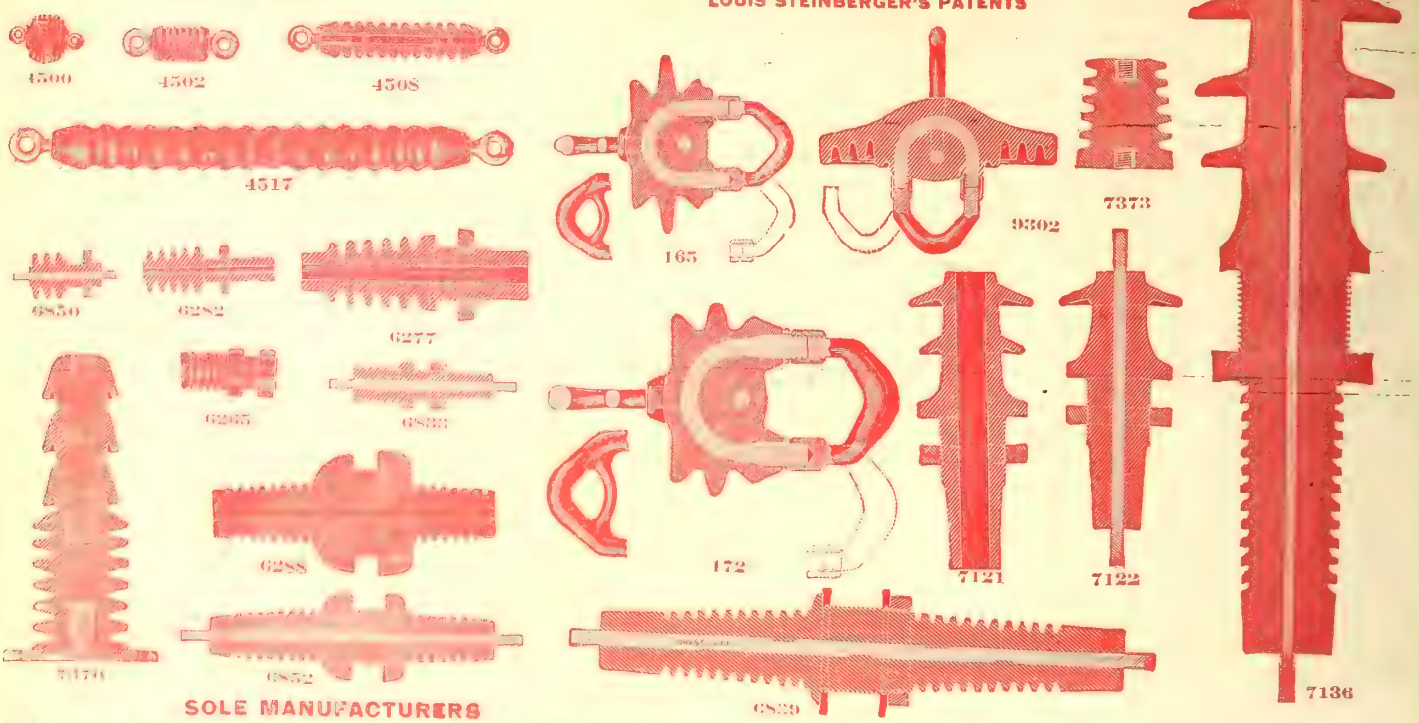
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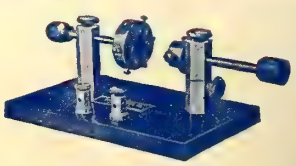
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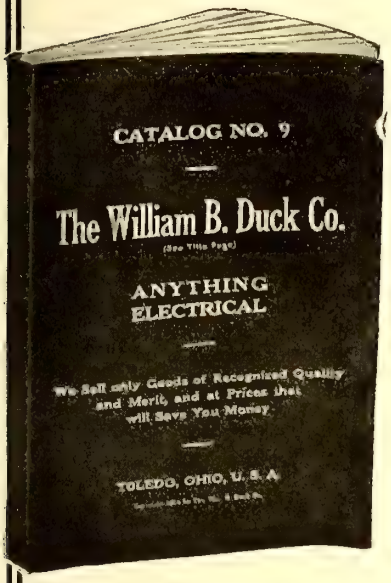


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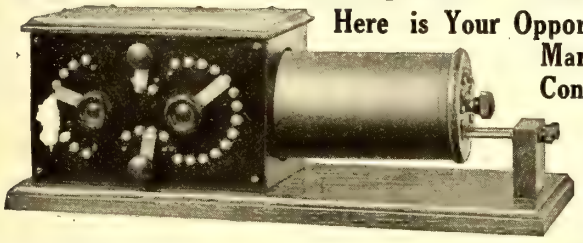
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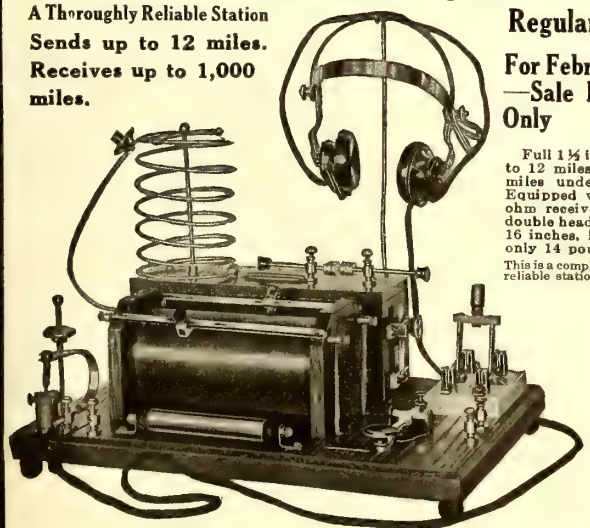
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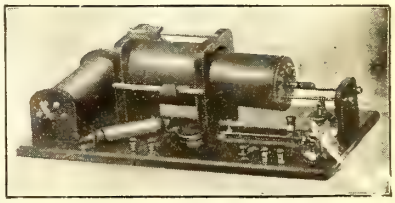


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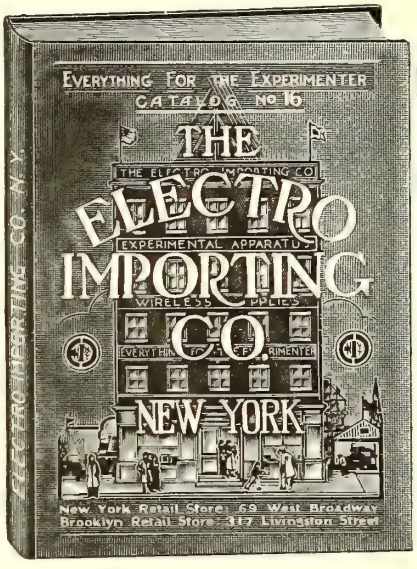
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Vol. III Whole No. 34 CONTENTS FOR FEBRUARY, 1916 No. 10

FRONT COVER—"AN ELECTRO-GYRO-CRUISER."..... From Painting by Thomas N. Wrenn —
HOW VESSELS AT SEA SIGNAL THROUGH THE WATER..... 533
NEW SEARCHLIGHTS FOIL THE ENEMY'S GUNS..... 535
THE TRENCH TRACTOR.....By H. Gernsback 536
GIGANTIC GAS-ELECTRIC LOCOMOTIVE..... 537
MINIATURE ELECTRIC BATTLESHIP "MASSACHUSETTS"..... By Carrol Wakeman 539
THE MODERN DETECTA-PHONE.....By Samuel Cohen 540
WHEN BELL INTRODUCED THE TELEPHONE..... 541
THE ELECTRO GYRO-CRUISER.....By Eric R. Lyon, A.B. 542-543
NEW TELEPHONIC NOVELTIES..... 544
NEW ARC LAMP CONSUMES NO ELECTRODES..... 546
MYSTERIES OF MATTER.....By John Candee Dean 548-549
NEW ELECTRIC SIGNAL FOR LOCOMOTIVES..... 550
AUTOMOBILE STORAGE BATTERIES WITHSTAND FIRE..... By F. C. Perkins 551
THE SHIRIKARI TENTACLE—(A SCIENTIFIC STORY)..... By George Frederic Stratton 554-555
"RADIO DEPARTMENT" 557
THE MARVELS OF MODERN PHYSICS..... By Rogers D. Rusk, Assistant Instructor in Physics, Ohio Wesleyan University 556
LATEST DE FOREST RADIO APPARATUS..... 557
DUBILIER MULTIPLE MUSICAL TONE RADIO SYSTEM..... 559
THE ELECTRIC ARC AND ITS INTERESTING APPLICATIONS. By Morton W. Sterns 560
"RADIO LEAGUE" NEWS..... 562
"THE CONSTRUCTOR" DEPARTMENT..... 563
CONSTRUCTION OF A COLLIN'S RADIOPHONE ARC..... By H. Winfield Secor, E.E. 563-564
OFFICIAL LIST OF RADIO AMATEUR CALLS TO APPEAR IN NEW GOVERNMENT CALL BOOK..... 567
"HOW-TO-MAKE-IT SECTION..... 568
WRINKLES, RECIPES AND FORMULAS. Edited by S. Gernsback. 571
WITH THE AMATEURS..... 572-573
LATEST PATENTS DIGEST..... 574
PHONEY PATENTS..... 575
QUESTION BOX..... 576
BOOK REVIEWS..... 597

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Forty Years of the Telephone

THE year 1916 marks the fortieth anniversary of the telephone perfected by Alexander Graham Bell in February, 1876, and patented by him on March 7 of the same year.

It is extremely difficult to realize that the instrument which has so revolutionized our every-day lives is but 40 years old, while to our present generation it seems incomprehensible how the world could possibly get along without it prior to 1876. But our fathers and mothers remember full well what inconveniences the daily life beheld before the advent of the uncanny little instrument; they know the drudgery of those days before the slogan, "Don't walk—talk!" had been coined. Forty years back it was "Walk, if you wish to talk!"

Of all the great inventions we know no other which has benefited humanity at large as much as Bell's telephone. Not only does it save us millions of unnecessary steps, but it brings us together closer than ever before. Space has vanished. When the Twentieth Century man of New York calls up his friend in Chicago or in San Francisco, he takes it entirely as a matter of course. He gets married over the 'phone, he calls up the Fire Department by 'phone and thus saves his house from destruction. Or if he is ill he calls up his doctor and is cured over the 'phone. In the course of the day he accomplishes a hundred more remarkable things with the little instrument accessible to the humblest as well as to the richest man. He can accomplish more in a day than either Alexander or Caesar could accomplish in a month, and still he complains of his lot!

As remarkable as the telephone is in its broad field, as remarkable as its career was, so remarkable an exception is it among the great inventions. During the first few years after its appearance it was met with incredulity and derision and Bell, the young struggling inventor, was forced to walk a long path strewn with thorns. It is a matter of history that as wise a man as Senator Platt, of New York, to whom Bell went for financial support, ordered his secretary to "throw that fool Bell with his fool talking machine down the stairs if he calls again." Nor was it encouraging that five minutes after Bell's patent attorney had handed his patent application into the Patent Office, Elisha Gray appeared with a similar patent application at the Patent Office. Few inventions have been subject to more litigation than the telephone, for there were untold millions at stake, but Bell triumphed and his basic patent was upheld by the highest courts. Likewise few inventors have reaped such an immense benefit from their invention as has Bell, nor have many lived to witness such a tremendous as well as universal application of their invention. There is no civilized country on earth where the telephone is not known and used daily; there is hardly a child who does not know what a telephone is. The number of the telephones scattered over the globe reaches in the millions, New York City alone having over 650,000 'phones, or more than London, Paris and Berlin combined!

Most remarkable of all, however, is the surprising fact that the telephone receiver which we use daily is practically the same instrument as the one made in 1876. The shell, the magnets, the coils, the diaphragm are identically the same; 40 years of advance in the electrical arts have left the telephone untouched. Bell's original instrument has not been improved to speak of; his receiver has stood the onslaught of time and brains. Only minor improvements have been made, the construction as a whole remaining the same.

Not only has the telephone found a wide field of usefulness for transmitting speech by wire, but without its use wireless telephony would not be possible. The telephone is used to listen to the criminal's faintest whisper; the European nations at war now use it under water to detect the deadly submarine; the ships at sea with it listen to the tolling of the submarine bell to guide their course in a fog or at night, and we could name a dozen more equally interesting applications of this wonderful little instrument.

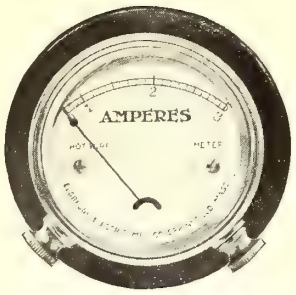
When congratulating Bell this year, let us pray that he may live to see the day when some experimenter perfects the so necessary adjunct to the telephone, the *Telephot*, whereby you can see your friend over the wire while talking to him.

H. GERNSBACK.

THE ELECTRICAL EXPERIMENTER is published on the 15th of each month at 233 Fulton Street, New York. There are 12 numbers per year. The subscription price is $1.00 a year in U. S. and possessions. Canada and foreign countries, $1.50 a year. U. S. coin as well as U. S. stamps accepted (no foreign coins or stamps). Single copies, 10 cents each. A sample copy will be sent gratis on request. Checks and money orders should be drawn to order of THE EXPERIMENTER PUBLISHING CO., INC. If you change your address notify us promptly, in order that copies are not miscarried or lost. ***A green wrapper indicates expiration.***

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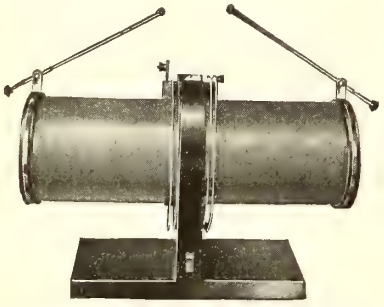
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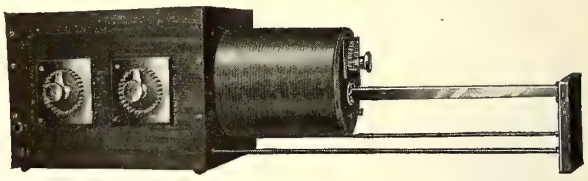
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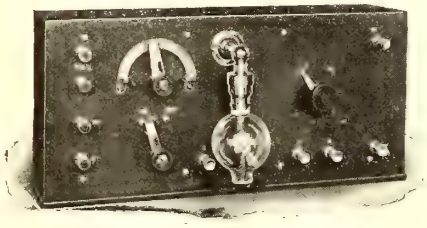


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Vol. III. Whole No. 34 FEBRUARY, 1916 Number 10

How Vessels at Sea Signal Through the Water

SUBMARINE signaling is a science not very well known to the general public, as little has been published on the subject. However, this method of signaling, utilizing primarily the basic principle that sound waves can be transmitted through water much better than through air, has received extensive patronage both in this country and abroad, especially in the merchant marine. Besides submarine sound wave signaling is of great service to submarine war vessels, for it can be used for inter-communication between ships and between ships and shore stations.

The great scientists Tyndall and Raleigh devoted special attention to the propagation and reception of sound waves in air, but there the matter apparently was dropped until Arthur J. Mundy, of Boston, some years ago, suggested the use of water mitting such signals through and proceeded to prove its value for such purposes by practical demonstrations.

The advantage of water over air for the transmission of signals are many: In the first place, it is free from the dangerous zones of silence which occur when the signals are produced in air. The absorption of the sound is much less in water, and consequently the signal is not only absolutely reliable but is transmitted to a distance many times greater than when it is transmitted through air. Sounds in the water are not carried away by the wind in stormy weather, as is the case with the Siren. Sound waves through water are not affected by atmospheric disturbances, as is the case with wireless, to some extent at least. Again it permits the accurate determination of the direction from which the not the case with any other form of signaling service now available for ships.

Finally the work of Mundy, Wood, Fay, Williams and others working along this line resulted in a completely practical system. The illustrations herewith show some applications of modern submarine signaling, as well as the bell and indicator used in this remarkable system of intelligence transmission and reception.

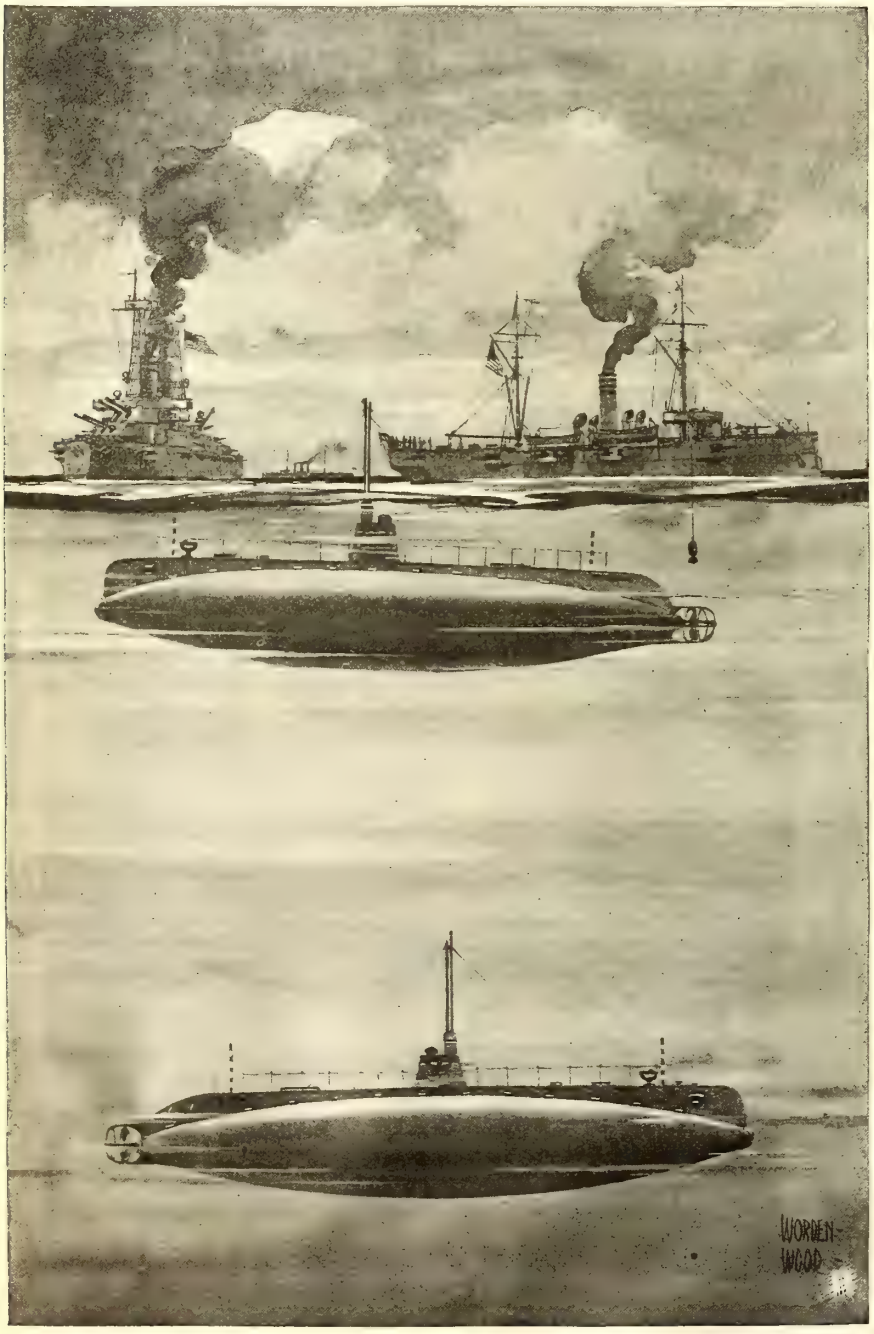


(C) SUBMARINE SIGNAL COMPANY

Sinking Liner Found in Fog by Submarine Signaling Bell.

The sound waves as used in submarine telegraphy are set up by one or more compressed air or electro-magnetically actuated sound disseminators, one of which is illustrated herewith in Fig. 1. This transmitter consists of a 220-pound bell, about 15 inches in diameter, attached to a case containing the actuating mechanism. This is of simple construction. It comprises a large electro-magnet, which attracts a disc shaped

to the rod which moves the hammer of the bell. The bell may be suspended from a cable over the side of the ship as one of the larger illustrations indicates, or in case it is used along the shore, it may be suspended from a tripod resting on the bed of the harbor or ocean. The tripod in such cases is made of steel channel beams and stands about 21 feet high. A waterproof cable leads from the electric bell to the shore station which is generally located in



(C) SUBMARINE SIGNAL COMPANY
Submarines and Another Ship Maneuvering by Submarine Signals.

a lighthouse, for in this way the attendant can cause the bell to give out its note as desired, either continuously as a warning signal against fog, or in short and long strokes as in sending a message by the Morse code.

The sound waves thus transmitted through the water (at the rate of aproximately 4,400 feet per second) are picked up or received by a supersensitive microphone. It has been found best to mount

noise due to the machinery on board the ship and the water noises will be eliminated. One of these microphone tanks is mounted on each side of the bow, inside of the ship. From each tank wires are run to a device which is known as the indicator box, shown in Fig. 2. This comprises a switch so arranged that by throwing the handle to one side the starboard microphone is connected to the telephone and by throwing the handle to the other side the port microphone is connected to he telephone receiver. These receivers are furnished in duplicate. Thus it is obvious that once the bell signal is picked up the captain of the vessel has only to turn his vessel until the sound is heard with equal intensity on each side to know that his ship is then pointing in the direction from which the sound is coming, and in this way he can take compass bearings of the lightship on which the bell is situated, if such happens to be the source from which

feasible and has become possible indeed through the use of later developments along this line, principally those of Prof. R. A. Fessenden, of wireless fame. He employs for the purpose what is termed an "oscillator." Its construction is shown in Fig. 3. In this sectional view the iron of the magnetic circuit and the copper tube are shaded and the magnetizing coil is cross-hatched. The copper tube is at A, which lies in the air gap of a magnetic field formed by a powerful ring magnet B, built up in two parts, as perceived. The ring magnet is energized by the coil C, and produces an intense magnetic flux across the air gap containing the upper part of the copper tube, thence through the central stationary armature D, thence across the other gap to the lower pole face of the ring magnet and thence through the yoke of the ring magnet back to the upper pole face. Around the armature is wound a fixed winding, known as the armature winding, and which is reversed in direction, so that one-half of same is wound clockwise and the other counter clockwise.

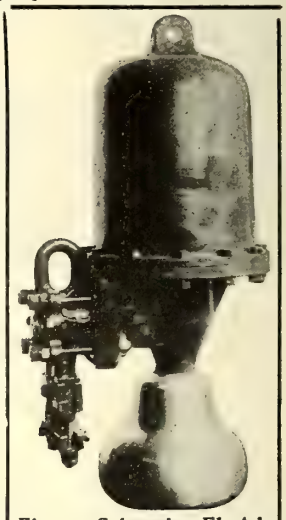


Fig. 1. Submarine Electric Bell.

When the alternating current is passed through this armature winding, it induces another alternating current in the copper tube. Only by this construction, it is said, has it been found possible to obtain the enormous force necessary to rapidly compress the water and thus make possible the rapid transmission of telegraphic signals through this medium, as well also as telephonic transmission.

Further, in order to apply this force now set up, an electro-magnetic reaction is started. In other words, to transmute this force into wave compression in the water, the copper tube is attached to solid discs of steel, which in turn are attached to a steel



Fig. 2. Indicator Box for Submarine Signaling.

diaphragm one inch thick, which may be

New Searchlights Foil the Enemy's Guns

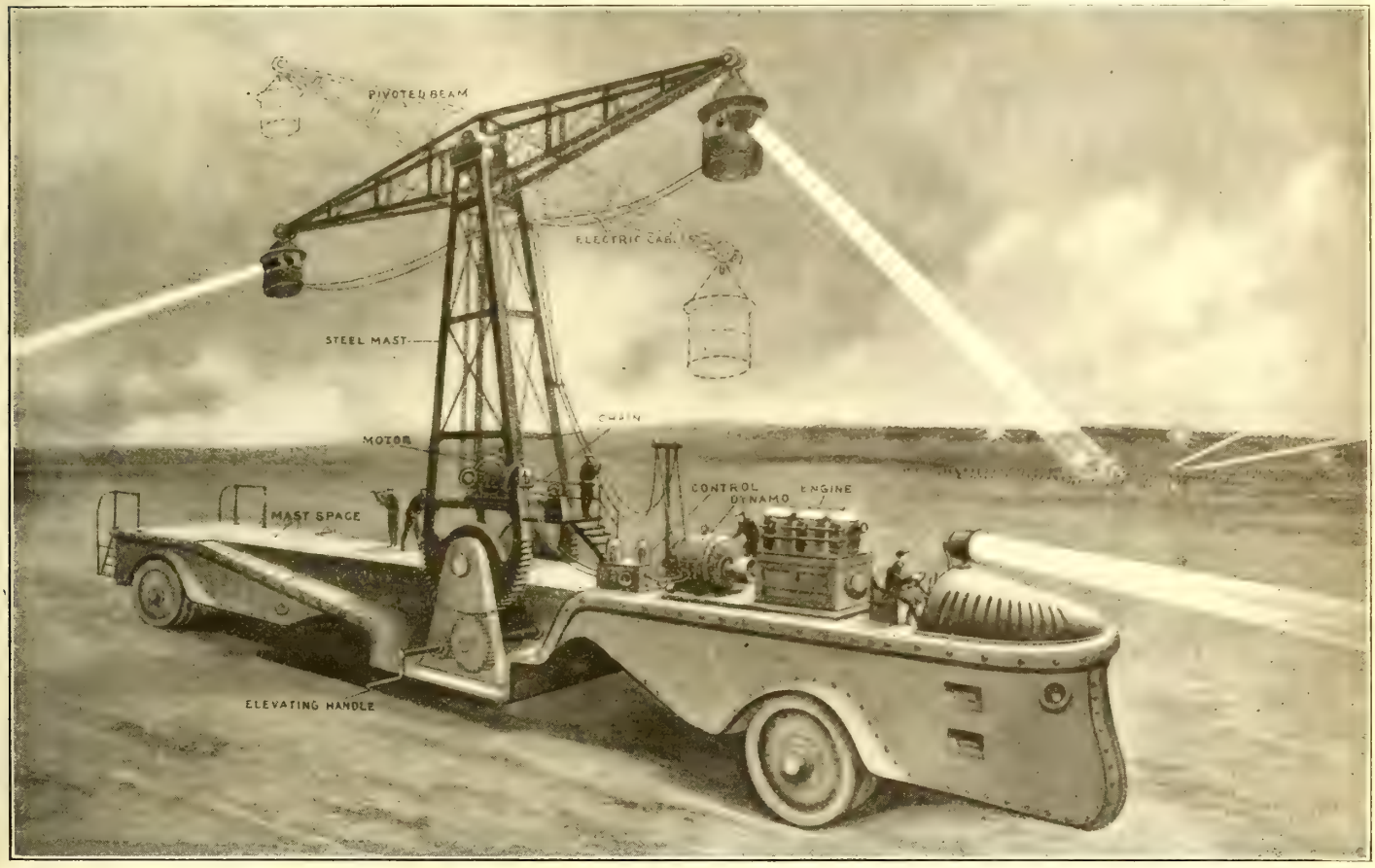
IN the illustration herewith is perceived a somewhat novel form of searchlight mounted on a rapidly movable or oscillating arm, which in turn is carried by a powerful motor truck so as to be very mobile and thus readily transported from place to place as required. This idea has been brought forth by H. Gernsback.

As is quite well known, a fixed searchlight, such as now used by the great European armies, becomes very quickly a target for missiles of all sizes and descriptions, which, needless to say, soon reduce it to a scrap heap. The gun spotters of today, even those in charge of large caliber field pieces, are notoriously accurate in their work, and unless a searchlight which is visible to them is constantly moved it is bound to be the unhappy target for a host of high explosive shells before many peaceful moments have passed.

To obviate these and other untoward difficulties surrounding the use of searchlights in night-time warfare, this design has been promulgated, and, as may be gleaned from the illustration, it is intended to use one or both searchlight beams at the same time. The motor truck of large size carries a complete dynamo and gasoline engine for running same, which is seen mounted behind the driver's seat on the truck. By means of heavy flexible cables from the dynamo the searchlights, which are carried in small cases when not in use, are supplied with current. When being used the projectors are constantly oscillated or moved up and down at an ever-changing speed. This is obtained by a hand crank, which is shown in the illustration.

However, it is possible to also effect this irregular up and down movement of the horizontal girder carrying the searchlight baskets by means of electricity. The electric control box for this arrangement is indicated on the truck. Such a mechanism may consist principally of a motor-driven drum having on its surface a considerable number of segments making contact with a pair of brushes. To every pair of segments on the drum there can be joined a different resistance, so that as the drum is rotated it will cause differing values of current to be supplied to the motor on the main pedestal, which in turn controls the up and down movement of the horizontal searchlight girder.

It is also very easy to arrange reverse current trips on the device just mentioned, so that the arm will move downward so many degrees and then reverse and move upward so many degrees. If desired, this arrangement may be modified in many ways so as to be adapted to stationary requirements. In such an event the truck could be made many times larger, most probably to advantage. Again, the center pedestal carrying the constantly moving horizontal arm could be swung about on its vertical axis so as to give greater play to the searchlights and also simultaneously to make them a more difficult target for the enemy's gunners. The dotted lines in the illustration show a second position of the horizontal girder carrying the searchlight baskets. It is thought that the constantly moving searchlights of this type are practically proof against the enemy's fire, as it would be impossible to accurately train a gun on them. However, it remains for such a device to be actually tried out before we can predict the results.



Remarkable Mobile Searchlight Tractor Designed to Keep the Searchlights Constantly Moving, Vertically as Well as Horizontally. A Difficult Target for the Enemy.

PROFESSOR ULIVI OUTDONE IN AMERICA?

Professor Montraville M. Wood, of Chicago, who spoke in Paul Revere Hall at Boston, recently, outdid Giulio Ulivi's claims for his F-rays in claims for the ultra-violet rays, which appear to be the same thing. According, however, to Professor Wood, the naval advisory board is in possession of "the secret of the ultra-violet ray" and the wonderful power it controls, and is conducting experiments with it, and he predicts that within a short time the turret guns of the ships of the United States will be operated automatically by the use of the ultra-violet ray, and that the guns will not fire until they are in a direct line with the object at which they are aimed. Men, except to load the guns, will not be needed.

In regard to the employment of time fuses in the starting of fires on board the ships carrying supplies, the professor says, what really happens is that someone, either off shore or on the ship, conceals a carefully tuned Hertzian ring in a lump of coal, and closes the cup, or gap, with a piece of guncotton. The ship sails, gets as far as mid-ocean. There is a sudden explosion, followed by fire. An operator on shore fired that ship, either by tuning his wireless coil until he reached the proper wave, or by bringing the ring in focus with the ultra-violet ray, or so the professor thinks.

DETECTS THUNDER STORMS 300 MILES AWAY.

Using a modified wireless receiving instrument, a French scientist has been able to detect thunder storms more than 300 miles distant.

The Trench Tractor

By H. Gernsback

BEFORE the advent of the monstrous 14-inch field guns, it was thought impossible to take a well-manned fortress by the then existing means. But since we have learned that the strongest fortress can be reduced within a few hours to a mere scrap heap it has become necessary to keep the enemy so far away from the fortress that his guns cannot reach it.

So the curious paradox has come to pass, as witnessed in the great war, that concrete and steel fortresses are protected no longer by stone or steel walls, but by human flesh sheltered by trenches.

Once two contending armies dig themselves in trenches, these armies practically cease to exist for their respective countries. They become deadlocked and up to this time, as the European war demonstrates so clearly, nothing has been invented whereby one army can effectively drive the other from their trenches. For over eighteen months at this time of writing the Germans and the French have been deadlocked, neither contending army having moved forward or backward for more than five miles. To be sure, local successes occur here and there and sometimes one or the other carries a few hundred yards of trenches only to lose them the next day.

The Germans being the first to realize the unsatisfactory results of trench warfare set out to devise some means to drive the enemy from his trenches. We are all familiar with the result whereby poisonous or asphyxiating gases were used. This plan worked well for a time till the enemy learned to wear respirators, and it is now a rare occurrence that a trench is won by means of gases alone.

What is needed to-day is a machine to effectually combat the men in the trenches by either destroying them or otherwise putting them out of action. This must be accomplished with great rapidity in order to quickly repeat the operations with the second and the third line of trenches. Then when a successful gap has been made, it will be a comparatively simple matter for the men to rush up into the break and *"consolidate"* the new advanced positions, as the French term this process.

The writer desires to advance a new idea by which to accomplish the foregoing, and while it may appear fantastic at first thought it is nevertheless not an impossibility. We need but remind the incredulous that but eighteen months ago the wisest military engineers outside of Germany would have laughed at the idea of running a 14-inch 140 ton gun over land. It was accomplished, nevertheless.

While the Trench Tractor as conceived by the writer is of course purely imaginary, we are not at all sure that a machine of this type will not roll over the ground in the not very distant future.

Briefly, the Trench Tractor is a huge two-wheeled monster, propelled by electricity and of sufficient size to "walk" over ordinary trenches with ease.

The imaginary tractor, as shown in our illustration, has two wheels, each 40 feet high and 15 feet wide. The business part of the machine is about 70 feet long and about 15 feet square. In it are carried 200 fully armed men, bomb throwers, a number of 3-inch and 6-inch guns, as well as machine guns, ammunition stores, supplies, wireless apparatus, a steam generating plant, the two power plants, etc., etc. The tractor is to run at a speed of about 20 miles and is estimated to weigh 10,000 tons. It is needless to say that the body of the machine is armored with a heavy plating so as to protect the men in the interior from the enemy's shell fire.

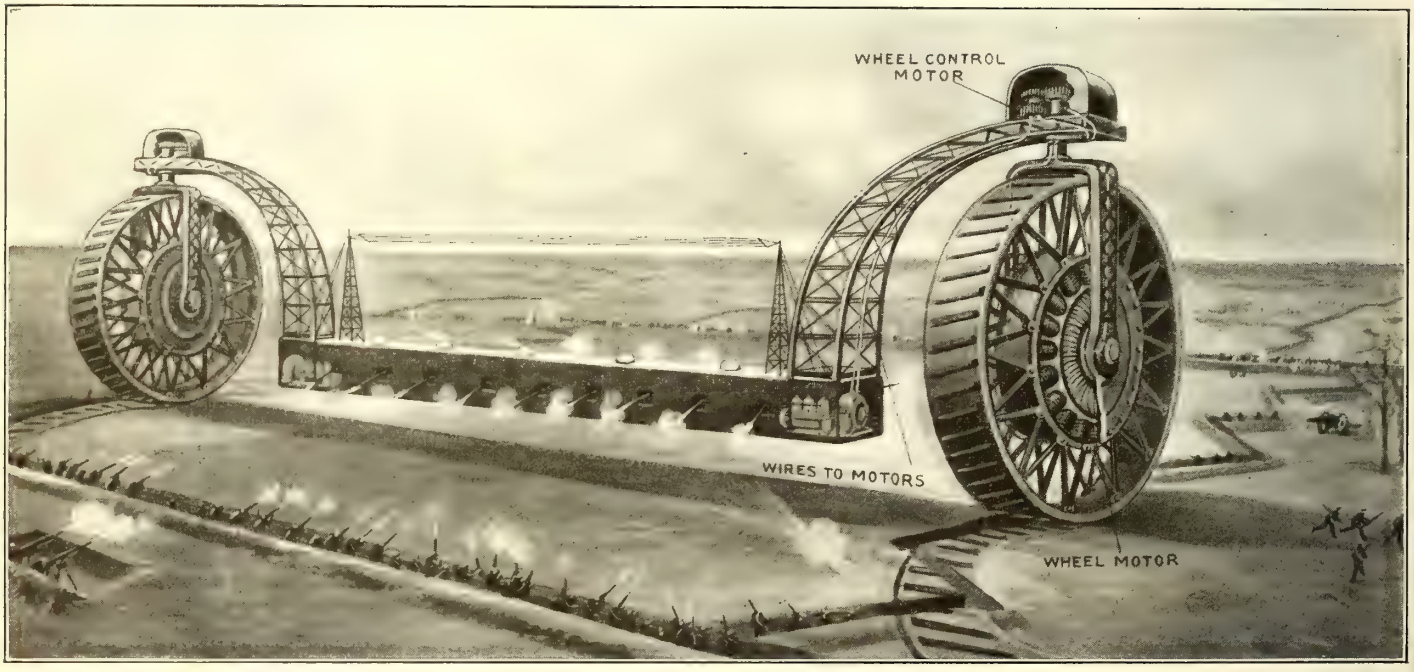
At first thought one would imagine that such a huge machine requires an enormous amount of power to move it at a speed of 20 miles an hour, but this is not the case. Moving over level ground but 2,600 horsepower are required, which is but 2,000 kw. The average electric train of 3,000 tons requires 605 kw. to move it at 20 miles an hour.

Thus our imaginary tractor, to run over rough ground or to ascend hills (in a zigzag line) would not require over 3,500 horsepower at the utmost. This is very much less than is used by a moderate-sized steamship.

The right wheel, which shows the detail of the motor which propels the former, is illustrated with the plating broken away to show the interior; both wheels, however, are of course heavily plated with armor to protect the motors.

Two independent high speed gasoline or oil engines are used to drive the dynamos, which in turn supply the current to the slow running wheel motors. As the wheels are so large they need but run at 14 revolutions per minute in order to drive the tractor at a speed of 20 miles per hour. For this, and other self-apparent reasons, the electric mode of propelling the machine is necessary.

In the illustration the tractor is shown running with its wheels parallel to each other. This is the fighting position. As the length of the entire machine, measured from one side of one wheel to the other is over 140 feet, the tractor could not of course run on a road. For this and other reasons the wheels can be turned about, bicycle fashion, so that the machine can run lengthwise. In this position it measures but 18 feet wide and it will roll comfortably on a road and even over a steel bridge. In this position also it offers but small surface to the enemy's fire.



A Powerful Land Fighting Machine That Can Travel Sidewise or Longitudinally. It is Capable of Carrying Heavy Guns as Well as Rapid Fire Machine Guns.

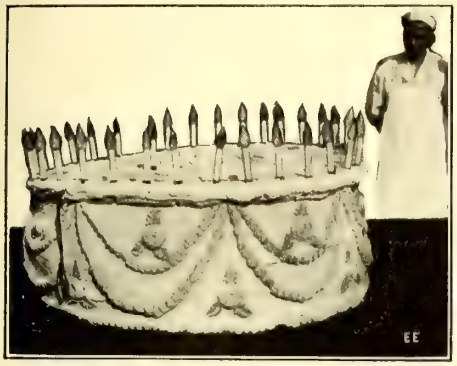
The body of the tractor swings about 10 feet above the ground, and as our illustration shows the machine has just run over the enemy's first trench. It therefore *attacks him in the rear.* In a few minutes the men from the tractor's regiment trenches will rush up and the enemy *will be under fire from two sides.* The enemy is overpowered while the tractor rolls over the second trench and repeats the operation there, and so on if other trenches are left. A less bloody variation of this may be had when the tractor stops right above the enemy's trench. By means of its steam plant live steam in great quantities may be let loose on the men in the trench below, and this method presents several advantages.

First, it is a very powerful argument to

(*Continued on page* 587.)

MAMMOTH ELECTRICALLY DECORATED BIRTHDAY CAKE.

What is claimed to have been the largest birthday cake ever baked is shown in the illustration herewith. It was made expressly for the 35th anniversary of a large department store in Columbus, O. It weighed nearly half a ton and required eight husky men to lift it. The dimensions were 4½ feet wide and 15 feet in circumference. It comprised nine toothsome layers, which were cut up after the celebration, so that each of the 15,000 visitors to the store received a choice morsel. The mayor of Columbus had the honor of cutting the cake.



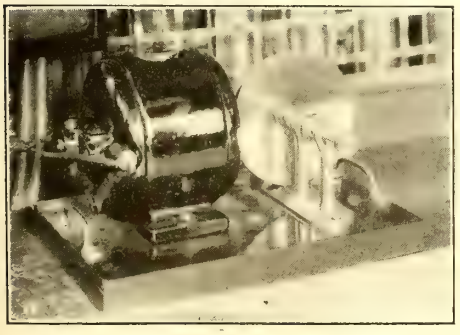
Electrically Decorated Birthday Cake That Weighed Nearly Half a Ton.

The ring of electric candles incorporated in the design of this huge layer cake was composed of a galvanized sheet iron ring 54 inches in diameter and 3 inches wide, with a groove pressed in the center to the depth of ¾ inch. Wires were placed in the groove and secured therein with the candle top terminals projecting upward. The sockets for the candle bulbs were attached to these wires and the porcelain shields completed the make-up, with the result here observed. The lamps were lighted from a 110-volt D. C. circuit, and in finishing the cake the ring with its attached lamps was placed upon same and then the frosting and pastry decorations were covered over the whole affair, so that neither the ring nor the wiring were visible at any place.

WINDING YOUR WATCH BY MOTOR.

Does the average man stop to realize the amount of energy required to wind his watch? It would be noticeable, however, indeed if he had to wind 700 watches every day. The winding of this number of timepieces became quite an important problem in a concern testing and repairing a large number of watches.

We have all heard of how Edison wound his watch by holding the stem of it against the guide in the elevator shaft, but it is quite impossible to use this method for winding 700 watches. Therefore the machine illustrated here was devised.



This Device Winds 700 Watches Daily.

This apparatus consists of an electric motor driving a shaft by means of a large friction pulley shown on the right. At the near end of the shaft is a small socket lined with felt which engages the stem of the watch. The only thing necessary for the watchmaker to do is to start the motor and hold the stem of the watch against the felt-lined socket.

As soon as the watch is completely wound, the tightened spring overcomes the friction between the motor shaft and the socket shaft. The spring is not wound tight enough to break it.

By this means watches can be wound very quickly and, in fact, this machine now does the work that previously required the services of several persons. Photo courtesy of New York Edison Co.

Gigantic Gas-Electric Locomotive

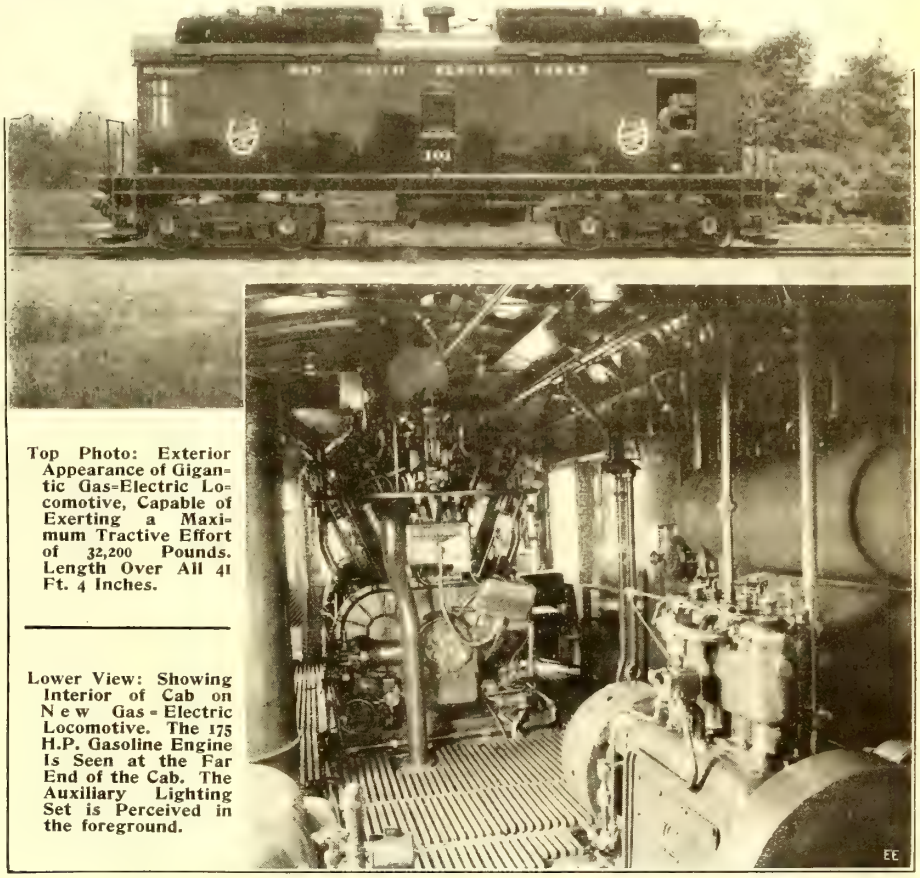
One of the largest electric traction corporations in the Middle West, which operates the "Dan Patch" electric lines, has recently received as an addition to its rolling stock three gigantic 60-ton gas-electric locomotives for improving its freight, passenger and terminal service.

These gigantic hybrid moguls were built by the General Electric Company. Their general external and internal appearance may be observed from the illustrations herewith. This electric traction road is said to be the first system of its kind in the world to be operated entirely by gas-electric service. One of the longest runs on this line is 107 miles.

The new 60-ton gas-electric locomotive here illustrated is of the double ended type and is built with the box type cab extending nearly the entire length of the underframe, with all the weight placed on the drivers. One engineer only is required to operate this locomotive, and it is claimed to be much more flexible in its control features and other characteristics than any other form of prime mover intended for railway purposes. The electrical generating equipment consists of a 175-horsepower, 550-r. p. m., 8-cylinder, 4-cycle gasoline engine of the "V" type. This is direct connected to a 600-volt, commutating pole, compound wound electric generator. Ignition of the engine is accomplished with low tension magnetos and the sets are started by compressed air. After starting one of these sets, of which there are two in each locomotive, the second set may be accelerated and brought up to operating speed electrically from the other set.

A very good feature in such designs as this, which marks a great step forward in locomotive evolution, is that the engines may rotate at normal speed irrespective of the speed of the locomotive and deliver their maximum power, which is a feature of great advantage on grades, in the case of snowstorms or other emergency conditions involving sudden, heavy current demands. There is an auxiliary gas-electric set which furnishes power for lighting the cab, headlights and train coaches.

The locomotives are propelled by means of four 100-horsepower electric motors of the commutating pole type. All four axles are therefore driving axles. The motors are ventilated by a special vacuum system in conjunction with the engines. These engines are capable of exerting a maximum tractive effort of 32,200 pounds. The length over all is 41 feet 4 inches and height over all 14 feet 10¾ inches, with an over all width of 10 feet 2 inches.



Top Photo: Exterior Appearance of Gigantic Gas-Electric Locomotive, Capable of Exerting a Maximum Tractive Effort of 32,200 Pounds. Length Over All 41 Ft. 4 Inches.

Lower View: Showing Interior of Cab on New Gas-Electric Locomotive. The 175 H.P. Gasoline Engine Is Seen at the Far End of the Cab. The Auxiliary Lighting Set is Perceived in the foreground.

The largest electric hoist in the United States has been installed in a mine in Butte, Mont. The new machine hoists at a speed of 3,000 feet per minute and can lift 14,000 pounds up a shaft 4,000 feet deep.

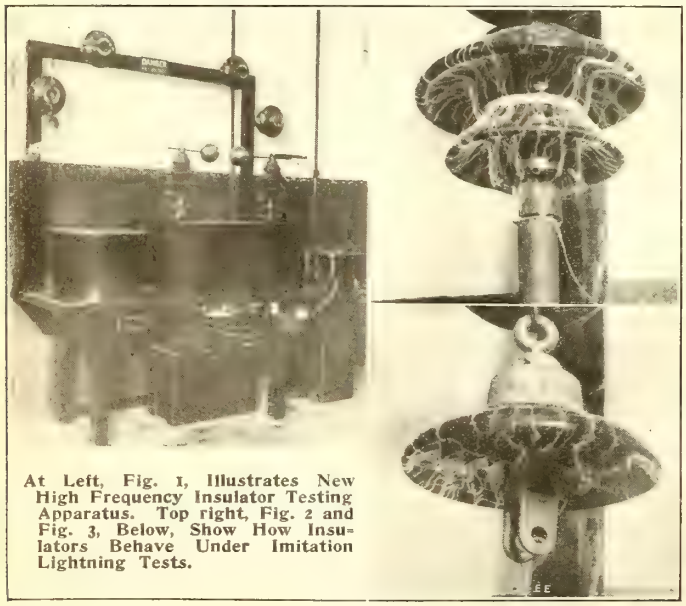
TESTING INSULATORS UNDER "LIGHTNING" CONDITIONS.

It has been common for many years to test insulators, particularly those intended for high voltage line work, at a potential of several times the normal working value at which the insulator is to be rated.

In the illustrations herewith Fig. 1 shows a special testing outfit as used by the Georgia Railway & Power Co., of Atlanta, Ga. These illustrations are reproduced through the courtesy of E. P. Peck, in charge of the testing department of that corporation. It has been definitely asserted that even when these insulators have been tested at four or five times the working line voltage on which they are to be operated normally that they would often and repeatedly fail for no apparent reason when the voltage piercing the insulator was known to be not more than one and one-half times the normal potential. It has been definitely deduced that the reason why the insulators fail in the manner just described is because of some high frequency disturbance on the line, as lightning, which has caused the insulators to be thus punctured. Lightning, of course, is a high frequency current invariably, and to imitate these conditions as nearly as possible has been the work of recent years of the foremost testing engineers.

The apparatus here illustrated comprises a high voltage step-up transformer, calibrated spark gap, together with oil immersed condenser, etc., arranged somewhat after the fashion of wireless transmitting sets for producing high frequency oscillations. The set here shown can be run up to 300,000 volts at 200,000 cycles. This apparatus is arranged so that the voltage may be increased by steps of a few thousand at a time and thus a considerable testing range is at the command of the engineer in charge.

Figs. 2 and 3 graphically illustrate the effect produced on the high voltage insulator as the current finally leaps over the surface when the voltage has been increased above the normal working value. Fig. 2 shows how the sparks have traversed up under and on both petticoats of the insulator; one high voltage terminal being connected to the pin supporting the insulator, while the second high tension terminal is mounted on top of the insulator. This method has been favorably received and considered by the best engineers in the country, and undoubtedly the time will shortly arrive when all transmission line insulators at least will be tested by this method, as in no other way can the effects produced by lightning be duplicated.



At Left, Fig. 1, Illustrates New High Frequency Insulator Testing Apparatus. Top right, Fig. 2 and Fig. 3, Below, Show How Insulators Behave Under Imitation Lightning Tests.

English Women Learn Wireless

The great European war has made possible the impossible and bids fair to change all the familiar landmarks and aspects with which the globe trotter is more or less familiar. For one thing, the women of Europe have taken up practically every branch of human endeavor, including the trades and professions.



At Left: Class of Enthusiastic Girl Students in the East London Wireless College. They Are Members of The Woman Signalers' Territorial Corps.

At Right: A View of the Women's Radio Class at Close Range. Here We See Them Actually Receiving Radio Messages on Commercial Type Instruments. Oh, Yes, They Understand Diagrams. Note Blackboard.

The illustrations herewith show how the English women are taught wireless telegraphy. The upper view shows the principal and a portion of the class in the East London Wireless College located at Forest Gate. These students are members of the Women Signalers' Territorial Corps. All the apparatus has been loaned by the Marconi Wireless Telegraph Co. In the lower illustration one of their multiple tuners with a magnetic detector is seen. A diagram of an oscillatory circuit is seen on the blackboard.

The young ladies are said to be very adept at picking up the wireless code and evidently mean to do their full share in the war's work whenever necessary. The women in France have taken the place of the men in practically every branch of science and industrial work. Practically all the street car motormen's and conductors' positions have been substituted by women and all the telegraph and telephone positions are said to be filled by them in a completely satisfactory manner. How these fair devotees of the radio art intend to climb aerial masts to make repairs, etc., cable reports fail to state, but we presume it is taken for granted that there will always be a man around some place to do such stunts.

NEW USES FOR VACUUM CLEANERS.

Vacuum cleaners are used to keep pool tables clean and to remove loose hair from freshly groomed horses. By grooming the horses electrically they are given a better appearance and there is no loose hair to get on the clothes.

SIGNS THAT TIMES HAVE CHANGED.

There are hundreds of families in every city that are still denying themselves the comforts and conveniences of our modern mode of living just because they have never worked out the proper answer to the question, "Can we afford it?" They have inherited the belief that electricity in the home means an expense that can be afforded only by the well to do. There are now many homes where the monthly bill for electric current in mid-winter does not exceed the cost of one roast of beef. They use the electric fan in summer, an electric heat pad in winter and electric suction sweeper each week, and the bill varies from $1.50 in June to $2.50 in December. Why not give the electric current a trial?

Miniature Electric Battleship

By Carrol Wakeman

A WONDERFUL electrical working model of the United States battleship Massachusetts, which took two and a half years to construct, has been recently placed on exhibition. It was built by Samuel Orkin, who labored on it an average of 16½ hours a day. This most remarkable little craft is built entirely of steel, and after setting the automatic timing device runs entirely alone. She is capable of running at a speed of 14 knots an hour for six hours, or will tow three men in a canoe at the rate of eight miles per hour. It carries 12 miniature 14-inch guns, 12 six-inch guns, four rapid-firing and two aeroplane guns, also six torpedo tubes. It is 13 feet long and two feet in breadth, having a displacement of 750 pounds and a draft of 9½ inches. She is manned by a dummy crew, which, in accordance with the size of the ship, are three inches in height. There are two derricks, which lift the miniature steam launches and swing them over the side into the water, where they run for 15 minutes entirely independent of the mother ship. The vessel is run by nine motors, three of which revolve the three propellers; the main motor developing one horsepower. The motors receive their current from specially designed storage batteries, having a capacity of 72 amperes. The portholes have lenses; but, should any water get into the hull of the ship, it would be forced out by pumps working automatically every five minutes. A rudder which has a resistance of 50 pounds steers the ship automatically in any direction.

When the automatic device is released, and the various motors commence to work, magic is out-wondered. Suddenly the clash of a miniature band playing "The Star-Spangled Banner" rings out, and as the flags are hoisted slowly signal lights begin to flash in the fighting masts, real wireless messages are being sent, miniature metal sailors run along the decks, opening the doors and shutting them, saluting exactly as though they were human. They climb the shrouded ladders and begin to operate the 12 searchlights, throwing the powerful rays in all directions, at the same time elevating them at all angles.

Then you gaze in wonder! Sharp sparks of real wireless messages are sent out, signal lights are flashing Morse code to other imaginary ships, and did you know the code you would ascertain that the officers of the dreadnought are flashing orders to other ships to fall into double battle line.

The doors in the superstructure of the ship swing open, and over 200 bluejackets, running from all parts of the deck, disappear through them into the heart of the vessel.

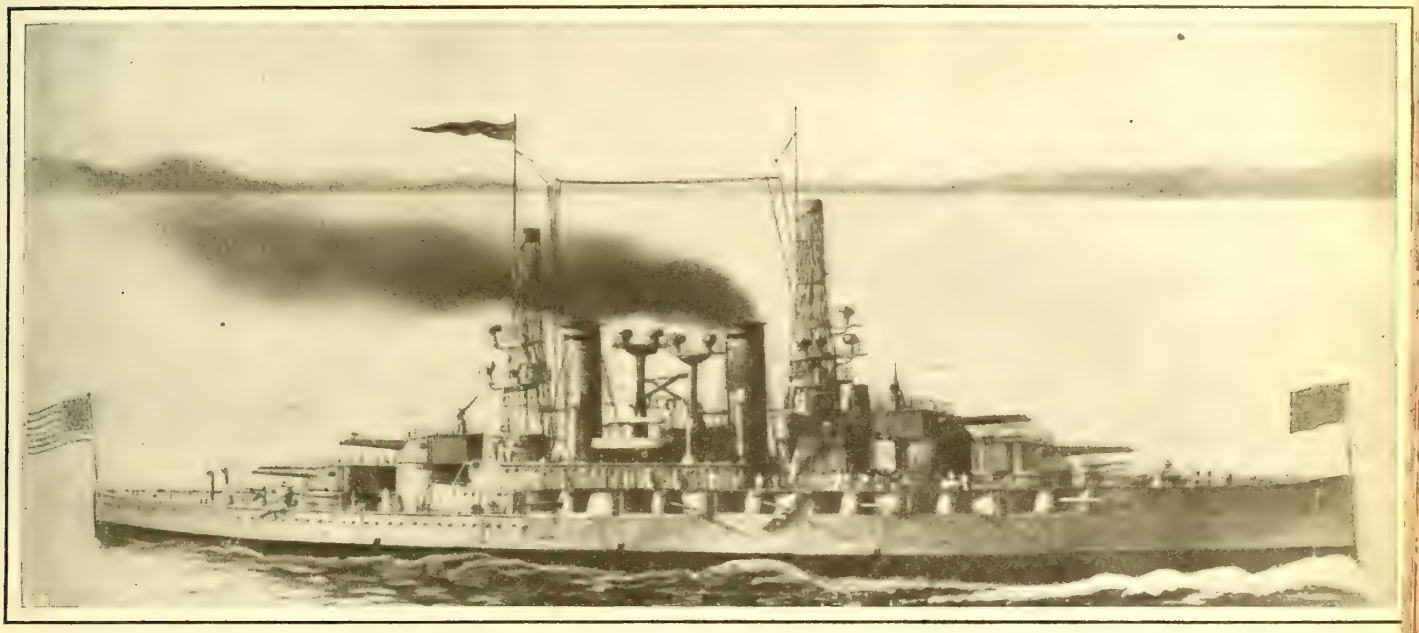
Suddenly an order is given, the siren whistle signals to clear the harbor, and anchors are hoisted automatically. The propellers begin to revolve and the rudder turns in response to the steering levers operated by the officer on the bridge, and this mighty engine of destruction is under way.

With her decks cleared for action and her crew below, all save the little group clustered around her commanding officer, you see her steaming away with a trail of smoke belching from her smokestacks. As she is maneuvering, the lower of the superimposed turrets swing to the right and a puff of smoke leaps from one of them.

Instantly the next gun speaks, and the next. When the turrets swing again, this time to the left and a full broadside is fired, the report is tremendous from all 12 guns.

Now the after turrets are taking up the cannonade, shooting their spirals of smoke far out and filling the air with the smell of powder. Next, the warship draws closer to the imaginary enemy, the smaller guns in the broadside batteries—the six-inch guns—come into action, swinging to a new angle at each shot.

When the supposed enemy has been sunk the battleship slows down in speed. The doors in the superstructure open again and her ship's company pour out again. The boat is steered automatically to the shore, wireless messages being sent to the victorious sailors. (The boat is steered automatically to the shore.) The band strikes up "The American Patrol," the siren shrieks, to clear her path, sailors marching, flags hoisting up. Gradually the ship draws near the shore, the band stops playing, the sailors enter the cabins and the boat becomes motionless. As the automatic devices have stopped, it would take but a minute to repeat the same or send her in another direction. Mr. Orkin intends to build next a complete fleet of boats having submarines, torpedo boats, aeroplanes, et cetera. Then a genuine sea battle in replica can be faithfully staged, giving a most wonderful sight.



A Replica of the U. S. Battleship "Massachusetts" in Miniature. It Measures 13 Feet Long and by Means of Electricity Fires Guns, Flash Searchlights, Signals by Radio, Etc., Most Realistically.

WAR EXTENDS APPLICATION OF WIRELESS.

France has about 10 wireless stations, the most powerful being the Eiffel Tower. The Germans have a great many more, especially the big station at Nauen, with the transmitting power occasionally raised up to 7,200 miles. They have a similar post in Spain, and until recently operated directly from Sayville, L. I. The latter plant is now in the hands of the United States Government, and German operators are not permitted to dispatch messages. The Sayville plant apparatus was made in Germany.

When the cables connecting America and Germany were cut the great wireless system in nowise impaired Teutonic communications directly with the United States. It has been shown that the power of the German wave from this station paralyzed almost entirely all other wireless communications. It is said that as much as 90 per cent. of the successes of the Germans offense and in escapes have been due their innumerable wireless stations.

GERMANS TAKE CABLES FOR COPPER.

Abandonment of little-used cable street car lines, so that the copper may obtained for war purposes, has been ordered by the municipality of Kiel, Germany according to a Reuter dispatch from Copenhagen, which says that the work of tearing up three streets for this purpose has begun and that about 3,000 yards of cable, weighing approximately seven tons, will thus be available.

Other lines are expected to be similarly treated in Kiel and other German cities.

The Modern Detecta-Phone

By Samuel Cohen

THE Detecta-Phone is an instrument for use whenever secret reporting of a conversation may be necessary. It is also used in aiding partially deaf people to hear. This instrument is so sensitive that the speaker may sit at a distance from the 'phone of 10 or more feet and the detective can hear the conversation accurately.

In detective work the transmitter of this apparatus may be concealed in any section of the apartment, such as in drawers of desks, in the walls, behind pictures, etc., and yet a voice in the room is accurately reproduced at the receiving end.

The Detecta-Phone comes under the class of electric devices commonly called "dictographs." They consist essentially of supersensitive microphonic transmitter, ade up of a large number of minute car- on balls (not grains) contained in a cup ade of the same material and a thin car- on diaphragm resting against these balls. ese parts are enclosed in a metallic case d are properly adjusted. The transmitter connected in series with a battery and ephone receiver, which latter is of the w-resistance type, and the instrument de- ibed here employs a 12-ohm receiver.

Several types of these Detecta-Phones ve been developed in the past years, but t invented by Gaillard Smith is one of most sensitive as yet produced. His in- uments are most employed by detective ncies, and, of course, a large number of them are used by deaf people. Our Fig. 1 (lower right) illustrates a Detecta-Phone used by the deaf. The transmitter is depicted on the right, while the receiver is shown toward the left. One of the features of the transmitter is a variable resistance for producing different intensities of sound in the receiver. Consequently, with this instrument one may vary the sound according to the needs of the user. The instrument is enclosed in a compact leather case, as shown, and can be carried around very readily in the pocket.

As was stated previously, the Detecta-Phone is used extensively by detective agencies. Fig. 2 (top right) portrays William J. Burns, the famous detective, using one of Mr. Smith's instruments. The transmitter is held in his left hand, while the index finger of his right points toward it. Note that double headset 'phones are used by detectives in order to get the full value of sounds produced in the transmitter. Practically every investigation made by the present detectives is entirely done by the use of these supersensitive telephonic instruments.

This inventor has also turned his mind to the development of these instruments for office work. Fig. 3 (top left) illustrates this application. Mr. Smith himself is seen using his Voca-Phone, which merely consists of a transmitter T of the type that has been previously described and two loud-speaking telephone receivers R R enclosed in a wooden case with suitable horns provided on each receiver, as is clearly shown in our photograph. One of the most important features of this Voca-Phone lies in the method of calling a certain party on the line. This is done by moving the transmitter signal arm toward the point on the scale corresponding to the party wanted. A small indicator is connected to this transmitter arm and travels across a small scale showing where this particular point is located. This scale is shown at the bottom of the Voca-Phone. A small push-button is provided on top of the instrument and it is used for calling purposes. In using this instrument one need not stand near the transmitter as in the present mode of telephoning, but the user may sit comfortably back in his chair and simply talk in a moderate tone. His voice is very readily transmitted to the receiving party.



op Left: Mr. Gaillard Smith, Inventor of Detecta-Phone, Using His Loud Talking Desk Telephone. Top Right: Detective Wm. J. Burns Uses the Detecta-phone. Insert View Shows Parts of New Tuned Microphone. Lower Left: Craig Kennedy, of Movie Fame, Employs the Smith Voca-Phone. Lower Right: New Supersensitive 'Phone for the Deaf.

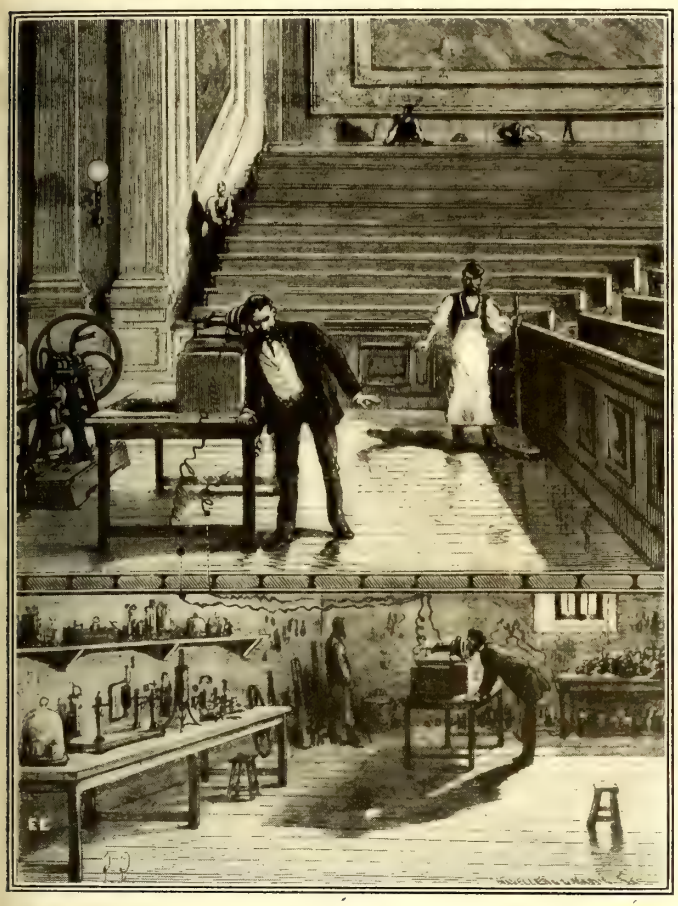
The Voca-Phone has been utilized recently in "The Exploits of Elaine" film. Fig. 4 (lower left) shows "Craig Kennedy," the detective, receiving some startling information with it.

One of the latest achievements in this line is a new "transmitter" whereby the musical "keys" can be exactly reproduced, and Fig. 5 (top right) shows this transmitter dissected. The upper central portion of the picture shows the make-up of the interior of the transmitter. A is the transmitter shell, made of a very light composition metal, and B the carbon cup. This cup is made of a special grade carbon, chemically treated, and contains six small holes as perceived. These cavities contain a large number of highly polished carbon balls, which are imported from France. These balls are hollow, making them exceedingly light for their size. The most important feature of this transmitter is the very small resistance coil C. A small contact arm D is used to vary the resistance on this coil. In order to produce a particular musical "key" the small handle D is moved to a certain point on the scale which is provided in the shell. The cap of this transmitter is shown on the right of the photograph, while toward the left the receiver is shown. When the diaphragm and cap are threaded upon the transmitter and properly adjusted it is a complete unit of itself, and can be carried around quite easily without distorting the interior parts.

When Bell Introduced the Telephone

1916 Is the 40th Anniversary of the Telephone

The telephone has become such a matter-of-fact apparatus that to-day none of us hardly ever stop to realize that it is possible that less than 40 years ago the telephone was purely a laboratory device of few and doubtful virtues. Men there were, and highly educated ones at that, who scoffed at Alexander Graham Bell's "musical ear," as it was at one time called, but so it has been in all ages with new discoveries.



Early Demonstration of the Telephone by Bell.

Bell, however, was a persistent and indefatigable worker and, unlike some inventors who have not lived to see the "child of their brain" developed and perfected to the wonderful degree attained by the telephone, he and his early assistant, Mr. Watson, have lived to see the telephone on practically every man's desk and on the wall of nearly every dwelling in this country and abroad.

The interesting illustration here reproduced is from an old wood cut and shows Prof. Bell trying out his somewhat heroic size telephone of early vintage in a lecture hall at Boston prior to a lecture and demonstration of the speaking telephone. Even the man with the brush is apparently somewhat startled, as well he might have been, for the telephone in those days was considered by most people as either a pure fake or as an incredible scientific monstrosity, but Bell knew better. In most of his early demonstrations and lectures it was usual to run a short copper wire line or circuit to Bell's laboratory, the illustration showing such an arrangement. In this case Mr. Watson did the talking at the labratory and the speech was reproduced by one of Bell's "speaking ears," which part of the human anatomy it very much resembled in those days, to be sure.

It must be realized that the apparatus with which this early inventor was struggling was a very crude and much misunderstood quantity. Nothing definite was known about the proper diaphragm to use, nor its size, nor was there anything definite known about the proper strength of the magnets to use, nor with what size wire they should be wound. Even though the proper size wire had been known, it is doubtful if it could have been procured, as magnet wire in those days was very scarce and usually had to be made to order at great expense.

Mr. Watson, who recently lectured before the New York Telephone Society on some of his early telephone lecture experiences in conjunction with Prof. Bell, related some amusing circumstances surrounding the public demonstrations in which the telephone did everything but talk. In some cases, needless to say, it took but very little to thoroughly provoke and send home an audience who were expecting to hear a *loud and perfect telephone*, "right off the bat," so to speak.

However, Bell's little instrument lived up to its promise in most instances and proved beyond the shadow of a doubt that the inventor could really reproduce the human voice by electrical and mechanical means. Mr. Watson mentioned one occurrence which had New Brunswick, N. J., for its locale. On this particular glorious occasion there was to be no less a personage than a grand opera soloist from New York City, who was to sing into the transmitter of the telephone at some distance from the lecture hall and the audience was thus to have a musical as well as a scientific treat, it was promised. But, like a great many other such things on which we calculate to the final dot, things did not go right, for the reason that the opera singer's voice was not quite suited to the telephone, of that day at least, so Brother Watson had to fill up the rest of the evening with suitable selections from his not too extended repertoire, and the audience went home well pleased, and none the wiser.

THE MYSTERY.

By G. LaPalma.

I AM the Swift—I am the Beautiful—I am the Terrible—I envelop the world with My Strength, and men thank God that I am, yet tremble in fear of My Approach.

I am old—so old the mind of man cannot conceive numbers sufficient to count the years of My Being, but still I am the Personification of Youth and Power.

For ages and ages I have played through the Heavens, and deep in the Bowels of the Earth I have wrought Mysteries yet unknown to man. I have lit up the skies with My Presence, and at the deep roaring boom of the thunder I have wrapped whole Forests in Sheets of Fire, smitten rocks to fragments, and sent, in panic, the wild beasts rushing through the jungle. I have played 'round the spindling towers man built, leaped o'er mountains, moved the wild sea, and found My rest in the bodies of people who know not My Presence.

Now man has found Me—A willing servant, I fetch and carry, lighting man's home and the streets, speeding his words on currents of air to far-distant countries, turning the wheels of thousands of mills, driving his cars in the city and doing his toil in the country. Oh! Countless are the things I give in Light, in Heat, in Power, yet even the ones who know Me best know nothing about Me. And though their hands are bold, their hearts are timid.

I am the World's Mystery. I am the Terrible, the Beautiful, the Omnipotent.

I am ELECTRICITY!

ALESSANDRO VOLTA.

Alessandro Volta, the inventor of the electric battery, was born in Como, Italy, Feb. 18, 1745, in a house where the Volta family had lived for more than 300 years. When a child, strange as it may seem, he was very backward. He was four years old before he spoke even his first word "No." From the time of this event, however, his mind seemed to turn entirely to the wonders of nature.. At 17 he won prizes in philosophy. When he was 18, the famous Abbe Nolet, impressed with the boy's great knowledge, had him write essays on electricity for the great men of the day, for people in general knew very little about this mysterious force at that time.

His first formal papers were issued in his 24th year. Fourteen years later appeared the Volta *electrophorus,* followed by his *electroscope*. Shortly afterwards Volta was made professor of physics at Como, and the year succeeding accepted what became a 40 years' professorship at Pavia. Experiments here led to the discovery of the *Voltaic pile* or battery, the first device ever made for producing continuous electric currents.

Famous throughout Europe, Volta received many honors, being created a Senator and a member of the French Institute. He remained personally, however, exceedingly unpretentious and was much beloved by the Italian peasants, who called him. "Il mago benefico," meaning beneficent magician. He died in 1826, but his name will live as long as electricity stands as our motive power, because the unit of electrical pressure has been designated as the Volt.



Alessandro Volta, After Whom the Volt Is Named.

The Electric Gyro-Cruiser

A Rolling Electric Gyroscope Fort of the Near Future. By Eric R. Lyon, A. B.

THE world will have wars for generations yet to come, but the time is near at hand when their destruction of human life must cease. How is this to be? Simply that all future war must be naval warfare, by which we mean there must be a navy for each of the three elements, earth, air and sea. We have our navy on the sea, and we have begun our navy of the air. Who knows but that our last and greatest navy stands now upon the threshold of human ideas, awaiting only a proper invitation for its entrance into our affairs?

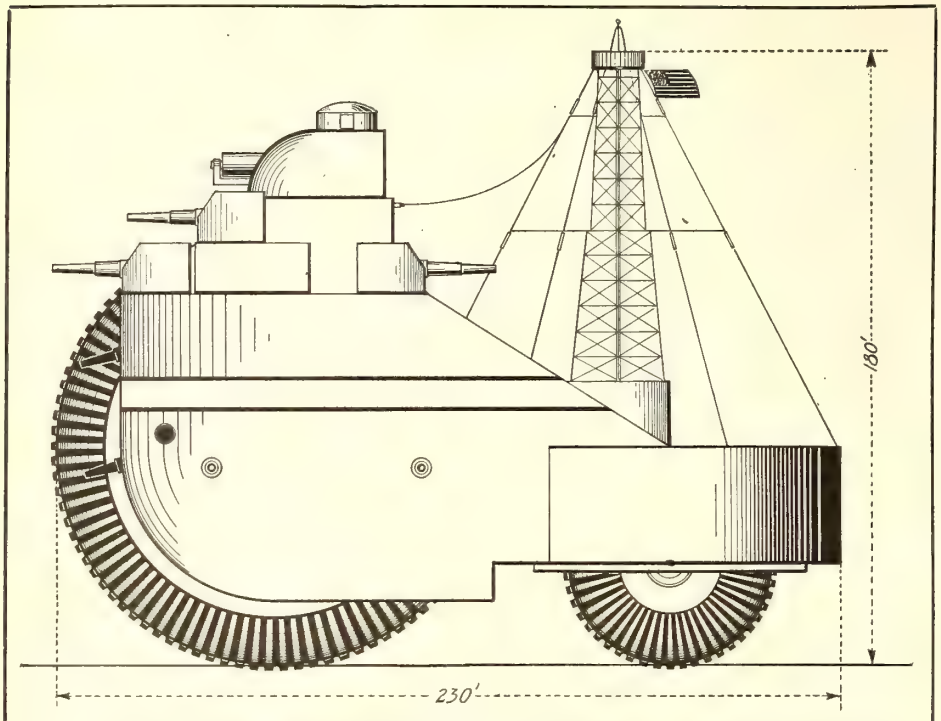


Fig. 1. Side View of Possible Land Cruiser of the Near Future. It Could Smash Any Fort With Its 42-Cm. Guns.

Suppose Great Britain's giant navy could now come up out of the sea into the plains of northern France and, mounting itself upon wheels, dash in single line formation at express train speed upon one single, unsuspecting and strategic point of Germany's hundreds of miles of battle front. What would happen?

We are told that "this is a war of ammunition;" that the decision of this war is practically a question as to which side can ultimately hurl the most tons of shot and shell into the trenches of his opponents. Now we know that if you and I and Smith and Jones and all of our neighbors are strung out over a hundred miles of battle front it is going to take an enormous amount of shelling to shell us out. But if the enemy should suddenly concentrate all of his fire upon Jones' pasture, or even upon 15 miles of battle front adjoining the pasture, there is not going to be one man left alive in all of that harnel ground to prevent the enemy breaking through. This, in brief, is the tactics of the present war. The enemy does break through. His infantry runs, his cavalry gallops and his big guns creep; all trying to get through the gap in our lines. In the meantime the warning has gone out broadcast to all of us. We rush in our reserves, and move up our own big guns to defend the breach. We storm the field. We mow down his necessarily massed ranks as with a reaping machine. We convert that 15 mile breach into a veritable inferno of hail, wind and destruction; or steel, fire and blood. The enemy is forced to retire; that is, all of him left to retire. We close up the breach, dig in again and await the next assault. This also is the tactics of the present war. Our infantry can move as rapidly as the enemy's infantry; our cavalry can gallop as hard as his cavalry, and our big guns can creep as slowly as his big guns. Consequently we were there in force before he could break through far enough to do him good. The net result of the whole encounter is another blood sacrifice to the war demon, and another call for ammunition on both sides.

Transferring ourselves from Jones' pasture to a point overlooking that select portion of the German battle front which we before mentioned, we may now imagine what begins to happen as the great British fleet comes in range behind the distant horizon. Our first warning of the impending battle is the increasing rattle of machine guns in the clouds, as the few local scouts of the German aerial fleet flee before the concentrated and overwhelming British aerial navy. Presently down comes a German Taube in flames. The British planes are circling far overhead and are signaling the ranges to the British gunners behind the horizon. The staccato roar of the German anti-aircraft guns has begun There is a distant rumble. The one remaining door of the hut in which we have taken refuge shudders, and immediately 10 or 20 bursts of flame search out the German batteries. In range of this 15 or 20 mile strip the Germans have 11 big howitzers. These are the chief concern of the British gunners. The British aerial fleet signals back the results. In the meantime one Taube scout has succeeded in landing behind the German lines. Ranges and movement of the British land fleet are immediately 'phoned to the German gunners. The big howitzers open fire, but the British aerial fleet, pursuing the Taube scout, had signaled warning to their land fleet when they could not prevent the scout's landing; and so, when the German 42-centimeter shells tear up a certain plot of ground behind the horizon it is from another point behind that ominous line that the first great answering salvo thunders forth. Through the glass we observe a distant German battery go up in flame and twisted steel. The thunderings become incessant and they seem to be coming nearer. Their salvos must be finding the targets. Suddenly the field has become alive with the bursts of six-inch shells seeking out the Germans' lesser batteries. Panic reigns. Through our glass we can see men and cannons dashing madly to new positions away from the bursts of those deadly pursuing shells. Yet not a man can we see going to the rear. The Germans have even in their despair resolved to stand their ground and die before the overwhelming onslaught. But neither do the British shells fall among the massed German infantry reserves, nor in the trenches armed only with machine guns and men helpless in the vortex of

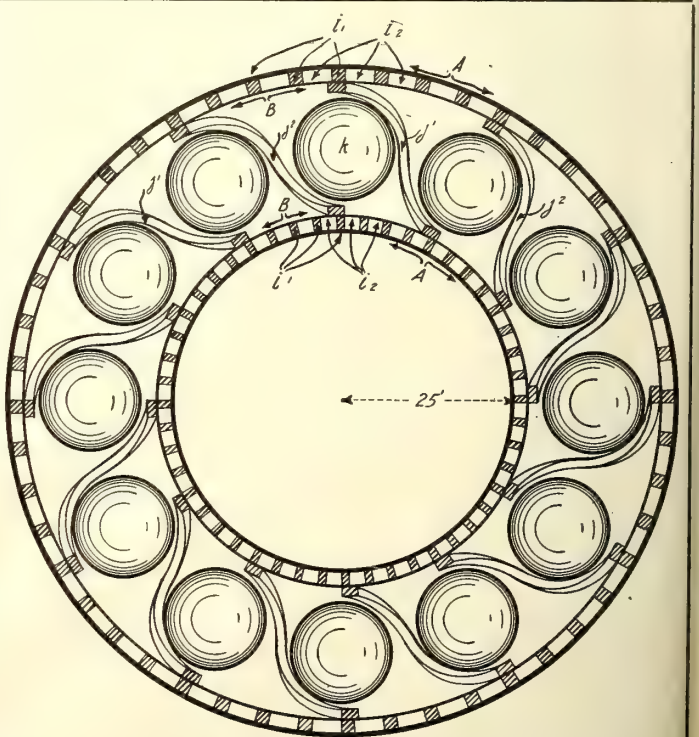


Fig. 3. Sectional View of Massive 2,000-Ton Liquid Gyroscope for Maintaining Equilibrium of Land Cruiser.

this maelstrom, for Britain has not elected to slaughter her enemies, but to overcome and to disarm them.

At last the hail of shell has ceased in the district under our observation and has swept out like a scythe into the far outlying districts. The breach has been made. The British monsters appear upon the horizon thundering, flaming, racing; bearing down upon us at express train speed. Onward they come. Presently one sweeps past into the gap and then another and another.

The memorable raid of the British land fleet had begun. It is recorded—and so it will be when the imagined incident here pictured shall have become a matter of past history—it is recorded that the British land fleet, having broken through the German lines, cut a swath of destruction through to Berlin more effective than even the famous Sherman's march through Georgia, and as they rode they destroyed every means of communication, of transportation; every munitions depot and provision depot; and ending with the destruction of the great Krupp works, there followed the surrender within a few weeks of the whole German army for lack of provisions and munitions. A new epoch was begun.

This is the picture of the possibilities of the new arm of military power. Now let us consider the probable form of its machinery. The form which first suggests itself is, most naturally, an overgrown reproduction of the common four-wheeled truck or wagon, and if such a device were designed to operate only over level ground or over especially prepared roads of about 100 feet in breadth it would be capable of good service and great speed. It would be possible to construct such roads all along the coastal country to be defended, and yet the four-wheeled units would be sadly hampered by their inability to operate away from the ideal conditions so prepared. If a unit of the future land navy, or a land cruiser we may call it, is to be of real service it must be able to maneuver anywhere over any kind of ground except precipices, and it must be able to make express train speed over common country roads and over the fields of gently rolling country. A device of this type is possible only when it shall employ some other means than a broad wheel base to maintain itself upright. Indeed, if the land cruiser is to be operated over country roads the breadth of its wheel base cannot exceed the breadth of the road, some 25 or 50 feet, which fact would necessitate balancing the structure upon not more than two great wheels—bicycle fashion. Going at full speed our huge device would be able to balance itself after the manner of a bicyclist, but it must also be able to maintain itself firm and upright even when standing still. To accomplish this there is one practical means of which we are aware, and that is the gyroscope.

Let us then call our land cruiser a gyro-cruiser. A likeness of what this may be we have in Fig. 1. Gyro-cruisers will begin, of course, very humbly, and at first will be gyro-trucks rather than gyro-cruisers. The conditions of mounting the gyroscope in the gyro-truck; the conditions of mounting the weight of the structure upon its wheels and, in fact, almost all of the conditions governing the small device will be different from those which will be found for the huge machine. So it is not with the steps upon the way, but with the type of the full-grown cruiser, of the gyro-navy in its prime, with which we are now concerned. Such, we may imagine, is the American gyro-cruiser shown in Fig. 1, with its extreme height of 180 feet from ground to top of fire control mast, its extreme length of 230 feet, its maximum breadth or beam of 87 feet and its maximum wheel breadth of 25 feet. The weight will be about 20,000 tons, one-tenth of which, 2,000 tons, will be the weight of the liquid gyroscope carried in the rim of the great wheel. The latter may be seen projecting downward and forward of the main substructure in the diagram, Fig. 1. The gyro-cruiser will mount 12 17-inch guns (or will they by that time have grown to 27 inches?) in six turrets, three of which are shown, the other three being similarly placed on the other side of the superstructure, and will be able to fire a salvo of eight guns in nearly every direction from the cruiser. Instead of the customary arrangement of low caliber guns, as in a battleship, an arrangement which is made necessary by the manner of firing with respect to the roll of the ship, the gyro-cruiser will mount in the 40-foot crown turret shown a huge machine gun, comprised of a rotating cylinder having mounted in it a sufficient number of complete and individually recoiling six-inch rifles, which shall be electrically fired as they successively pass through a predetermined firing position. One man will be able to aim and control the fire of a torrent of six-inch shells, and thus a weapon will be provided which, being peculiarly adapted to the gyro-cruiser, will give the latter added superiority to any other type of military unit operating upon the land. The great wheel shown in Fig. 1 is the traction wheel, and it is 108 feet in diameter from one beveled, cutting-edge foot to the other. The "little" wheel, which is 60 feet in diameter, is the steering wheel, and is also the balancing wheel—a fact which is apparent when we consider that in order for a gyroscope rotating in a vertical plane to exert its balancing power about a horizontal axis, it must be able to swing freely about a vertical axis. The uses of the aerial and fire control mast are obvious.

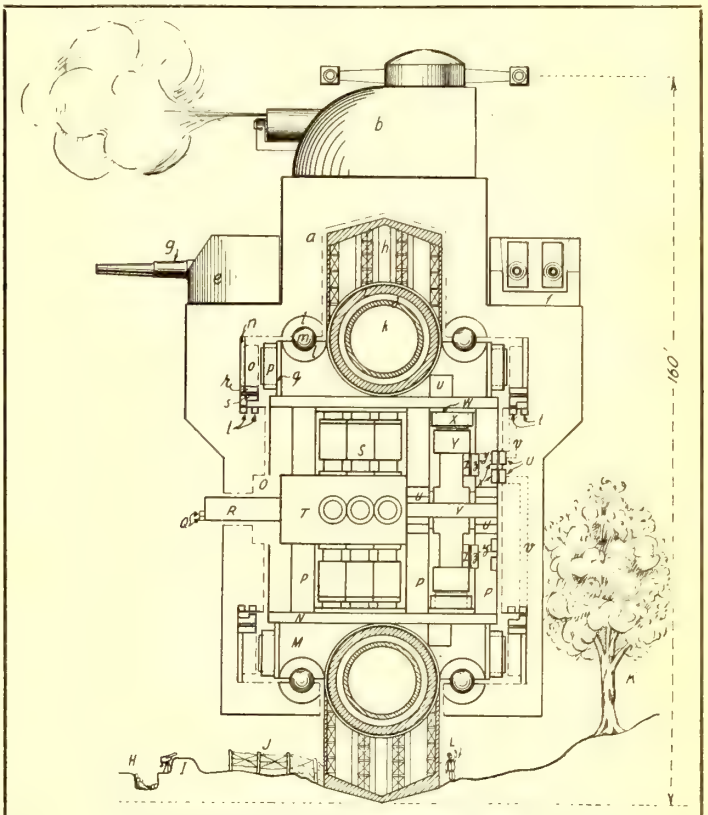


Fig. 2. Front Sectional View of Mastodonic Land Cruiser of the Future. Note Comparative Size of Man Here Shown.

Passing to Fig. 2 we have a detail, vertical cross section cutting the cruiser in a plane passing up through the center of the great wheel. We will follow the latter in explaining this diagram. On top is the crown bridge. It is heavily armored, rotates like a turret and carries the armored range finding arms, the eyes of which are now staring at the reader. Other range finding stations will be located at the top of the first control mast and at various points about the cruiser. It shall be the duty of these stations, not only to obtain the ranges of the enemy's positions, but to maintain an accurate running survey, analogous to the log at sea, from which the exact position and orientation of the cruiser may be told at any time. The complete control of the cruiser will be centered in the crown bridge, but there will be duplicate control stations in the main bridge (a) and at other points. The officer on watch at the crown bridge's range finder will have complete control of the cruiser, and he will electrically train and fire all of the guns, at the same time following the results of his own operations through the huge telescopic range finder.

(b) is the crown turret carrying the six-inch rifle machine gun described; (a) is the main bridge, offices, range plotting rooms, etc. Forward of this, but not shown in any of the diagrams, is the main searchlight station; (e) is a 17-inch gun turret, side view; (f) is the same, but looking into the business end of the guns; (g) is a 17-inch gun; (h) is the bevel-faced and very heavily armored foot or rim of the great wheel.

All inside of the broken line .—.—.—. is part of the great wheel and rotates with it. The armor of (h) is put on in plates parallel to the plane of the wheel, which is to say, perpendicular to the plane of the section. The plates will be welded together, making the rim of the great wheel one solid mass of steel capable of supporting the weight which it must bear and capable of withstanding the enormous centrifugal or bursting effort of the liquid gyroscope—the latter is carried immediately below (h) in (i), (j) and (k).

(i) is a cross section of the lining of alternate magnet coils and iron rings in the tube of the liquid gyroscope; (j) is the space in which is wound the spiral of *non-magnetic* steel which causes the liquid to spiral round the tube in a second rotation impressed upon the primary one; (k) is the hollow propelling ball of iron and steel faced construction, 15 feet in diameter, which floats in the liquid and which is sucked around and around the tube by a rotating magnetic field, just as is the action upon the shell in the proposed electro-magnetic gun: (1) is the section of a ring of heavy welded armor which, like the ar-

(*Continued on page* 587.)

New Telephonic Novelties

LOUD SPEAKING TELEPHONE A BOON TO SALESMEN.

With this new adaptation of the loud speaking telephone, show window demonstrative advertising becomes a really convincing argument. It is no longer necessary to ask the audience to stand out in front of the window and read placards; instead, the demonstrator telephones his information right into the crowd, and he can tell them in the most business pulling arguments just why they should buy his wares.



Photo by Paul Thompson

This Salesman Talks to His Public Through a Loud-Speaking Telephone Fastened Outside the Show Window.

This new telephone apparatus for show window demonstrator's use was perfected into this highly practical instrument by B. H. Hogan, who, being a salesman, realized how important it is in selling goods to talk personally to the prospective customers.

The apparatus is a simple affair which can be detached in a few minutes and packed in a medium size traveling bag. It consists of a transmitter, into which the demonstrator speaks, just like into an ordinary telephone, but at the other end of the line is a horn, similar to that on a phonograph. In this horn, which is clamped to the building, just outside of the demonstrator's show window, is a strong electromagnetic reproducer which takes up the sound waves and throws them up against a sound board in the rear end of the horn. They are deflected back and out of the horn into the listening crowd. So strong is the voice reproduced that it can be plainly heard amid the surrounding street noises for a distance of 25 feet from the window. Sometimes two horns are employed, located 10 to 30 feet apart, to accommodate a large crowd, so that all may hear clearly every word the demonstrator says.

This new telephone derives its electrical current either from an electric light socket of 110 volts, or, in case no current is at hand, from batteries producing 18 volts. It will work either on direct or alternating currents; but, in case of the latter, the voice is harsh but by no means so indistinct that every word cannot be understood.

The apparatus pictured is being used by the inventor, it being the first one to be put to practical use in this line. The novelty of the situation never fails to draw a large crowd.

LATEST ELECTRICAL AID TO THE DETECTIVE.

One of the greatest obstacles encountered in the present dictagraphs, as used by detectives, is that of the unnecessary noises produced by the super-sensitive transmitter due to vibration, etc. Although various devices have been developed for the purpose of eliminating these sounds or side-tones, none of them has proved much of a success, but the one invented by Gaston Boissonnault, a prominent worker in this field, has shown far more superiority in its acoustic qualities than any one of the dictagraph type of instruments heretofore produced.

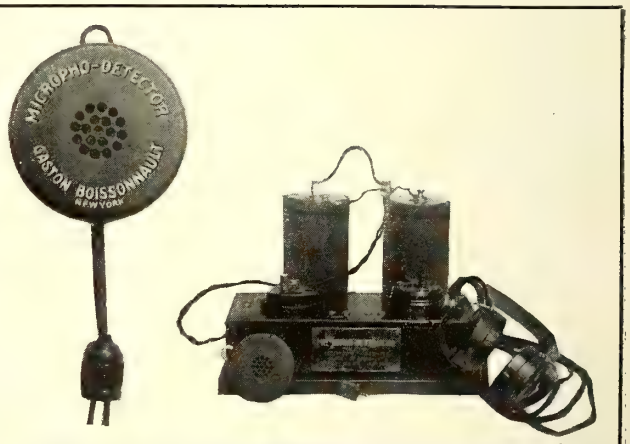
His transmitter or "sound collector," as the inventor calls it, is clearly shown in Fig. 1. This is constructed in the same way as in the standard type, but the various parts are more finely built and the carbon balls and carbon diaphragm are very highly polished. The outside side-tone noises are eliminated by the proper adjustment of the transmitter.

The receivers are a very important factor in this instrument; they are of the low resistance type, some of them varying in resistance, depending upon the condition under which the instrument is used; that is, some instruments require a low resistance 'phone because of the acoustic qualities of the room where the transmitter is placed; if it is a large room, a very low ohmage 'phone will be required.

The inventor, Gaston Boissonnault, has succeeded in improving his apparatus to such a degree of perfection that he has developed an instrument for detective work, and many of these are at present employed for that purpose. One of these detective type instruments is illustrated in Fig. 2. One of the clever features embodied in this outfit is the "fake" desk telephone seen at the right of the case. This looks exactly the same as the standard desk style instrument, but instead of having a regular transmitter a sensitive microphone of the type above described is placed in the microphone shell. The receiver is a "dummy" and it is not connected to any part of the telephone. Only two wires are brought down from the transmitter. This "phoney" instrument excites no suspicion whatever, as it appears to be connected with the usual Central Exchange and is naturally out of use as the receiver is on the hook, apparently. The listener can, however, hear through the instrument whether the receiver is on or off the hook. Three sets of receivers are used with the apparatus; one being seen on either side of the case and one in the center of the cover in the picture. The instrument is installed with a sound regulating switch. Two reels, carrying flexible cord, are shown standing against either end of the cover. The batteries are enclosed in the case, thereby making the complete outfit thoroughly portable and ready for instant service.

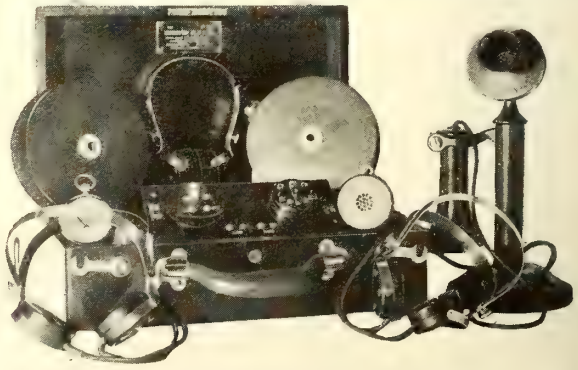
Another instrument of similar character is depicted in Fig. 3. This is of a smaller size and intended to be used in factories where several of these transmitters are located in different departments, while the receiver is placed either in the president's or manager's office, and in this way the "boss" is always secretly informed as to the condition of affairs in any particular department. He is also informed, secretly of course, as to whether his employes are talking for or against him, and thereby he can prevent strikes, providing the employes are plotting same, and in this way he is constantly informed about the inside conditions in his entire plant.

Several of these instruments have been advantageously used by several of the warring countries in detecting spies; plots were thus frustrated that were being talked over in the buildings and mansions around the battlefield.



At the Left (Fig. 1): New Dictagraph Microphone; at the Right (Fig. 3): Small Model of Dictagraph Set for Detective's Use.

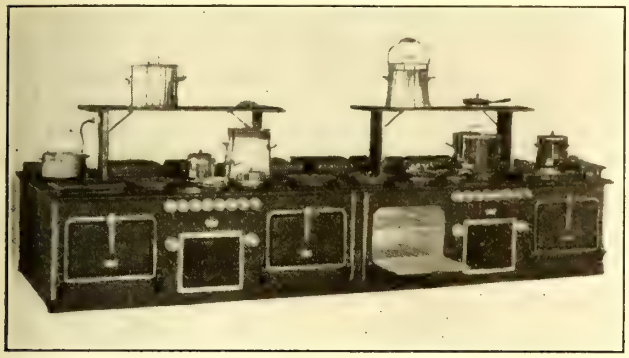
Below (Fig. 2): Complete Dictagraph Outfit for Detective's Use. Dummy Desk 'Phone at Right Contains Microphone.



Only 3.2 per cent. of fires requiring the attention of New York's fire department during 1914 were charged to electric origin.

Monster Electric Range to Cook for 1,500 People

Following a recent investigation of the practicability of electric cooking, the Montana State Hospital for the Insane, at Warren Springs, Mont., has purchased one of the largest electric ranges in the world for immediate installation in connection with an unusually efficient system of food handling and serving between the hospital kitchen and the dining rooms. The range is the largest ever built and has a total connected load of 69 kw. It is built in four similar sections, each 7½ ft. long and 2 ft. 9 in. wide, and is to be installed with sections back to back, occupying a floor space 5½ by 15 ft., enabling the cooking staff to work on both sides.



Giant Electric Range to Cook for 1,500 People at Montana State Hospital.

In general design the range is similar to one installed by the same manufacturers at the Southern Indiana Hospital for the Insane, which provides for 1,000 persons, but the Montana range has eight ovens instead of six and a proportionate increase in the top equipment. There are two ovens in each of the four sections, each oven having sufficient capacity to roast 24 chickens or 80 pounds of beef at once. Each section is a complete unit in itself, permitting their arrangement in any desired order. If the sections were placed in a single row the range would be 30 ft. in length. The range is of steel throughout, with polished trimmings, and is superior in workmanship and durability to coal and gas ranges. The top equipment comprises the following units, each controlled by a separate switch with ruby pilot light and three adjustable heats. Seven 10-in. by 24-in. hotel griddles with rims, two 18-in. by 24-in. flat griddles or hot plates, one 12-in. by 18-in. corrugated surface broiler, one 12-in. frying kettle for deep fat, one 6-slice hotel type bread toaster, five 15-in., two 10-in. and five 8-in. hot plates.

The heating units are of the enamel type and the controlling switches are conveniently mounted on the front of the range at a height providing for minimum labor in handling. The estimated maximum demand is 46 kw., and on the basis of 0.25 kw.-hour per day per person the energy consumption will be 259 kw.-hours per day, or 7,500 per month, making the cost of electricity, on a 2-cent rate, $150 per month. This is offset against the cost of coal, cost of handling coal and ashes and additional attendance required for handling a coal outfit. There will also be decided savings in food due to superior cooking as compared with coal or gas ranges, avoiding waste due to over and under cooking, excessive shrinkage, etc., which in many installations amounts to more than the cost of fuel.

UNIQUE CALL SYSTEM FOR BUILDINGS.

In an office building of 22 stories that is kept in good condition, there is a staff of mechanics constantly in service. To find the foreman of any of these gangs is a problem, since he may be in any of a dozen or so rooms. In the superintendent's office is a little switchboard with three flush switches each controlling a lamp on the board for a pilot and one of three over the freight elevator door on every floor, says B. R. Browne, in *Electrical Review and Western Electrician*. Red, white and green lamps are used. Each foreman has his call; for instance, the electrician's is green, the carpenter's red and white, the head porter's white, and so on. When the superintendent wishes to speak to any of the staff he calls by this lamp signal and the party called plugs a pocket telephone set that he carries into a little flush receptacle beside the elevator door on any floor and he is then in communication with the chief.

The whole thing is so simple and flexible that it could readily be adapted to suit any requirement of factory or office building.

By being placed near the freight elevator it is easy to wire, using conduit and condulet fittings. All that is exposed comprises three condulet receptacles over the door, the conduit running up the shaft and a short extension coming through the wall on each floor.

The pilot board is placed beside the telephone private branch exchange in the office of the building, so that the operator cuts off the signal when the conversation is closed. The lights are conspicuous enough for some of the staff to surely see, and yet are not as objectionable as a bell or other call in a public building. All stock materials can be used.

THE POTENTIOSTAT FOR HOSPITAL CALLING PURPOSES.

From time to time many clever and unique devices have appeared for use in hospitals, particularly for calling the nurse or the doctor, as the case may be. This new device, however, combines all the good points of all these ideas and has not a few original features.

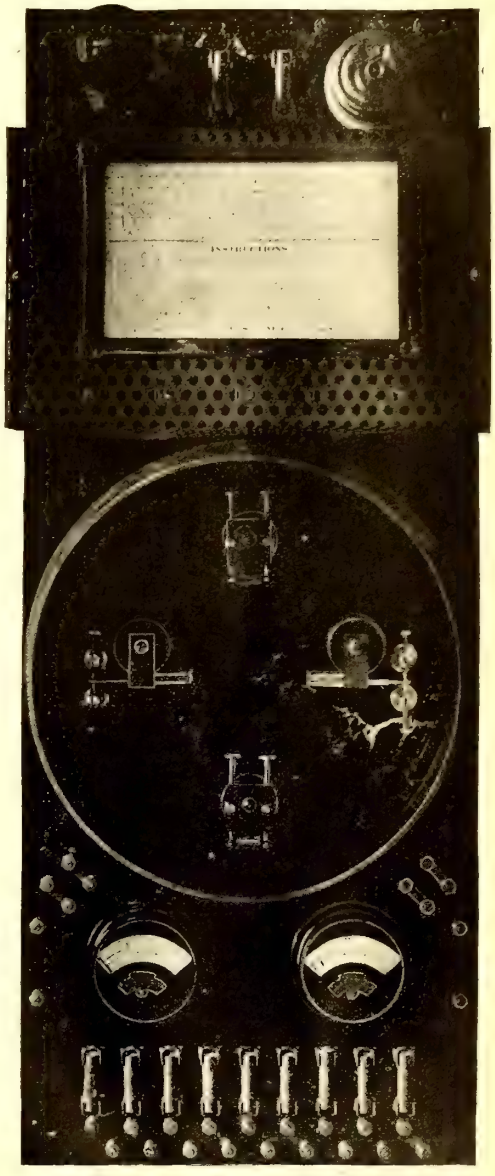
Primarily it consists of an automatic storage battery charging board and a push button of novel design, placed at the side of the bed. The apparatus is mounted in front of the nurse's or doctor's desk and miniature incandescent electric bulbs are placed on the board and operate in connection with the annunciator.

The complete system in outline works as follows: Whenever the patient desires the services of the nurse he merely presses the push button, which lights a certain lamp on the board and the annunciator indicates at once which patient is calling. The lamp remains lighted until the nurse answers the call. After attending to the patient she merely pushes another button placed near the bed, which extinguishes the light.

Practically all of the previous signal systems were operated on low voltage current, but the method of reducing same from 110 volts to the required voltage being very inefficient, made the operation of these systems on a large scale very expensive. This decided weakness and consequent expense was brought to the attention of several engineers and many devices were developed, but with very little success until an instrument was perfected for reducing high voltage to a lower voltage economically.

This is called the Potentiostat by its manufacturers and is herewith shown. In detail it consists of a number of storage batteries which supply the current to the lamps or bulbs. The batteries are charged automatically from time to time from the regular street mains. The charge is controlled by an automatic circuit breaker observed in the center of the Potentiostat. A volt-meter and ammeter are provided for determining the exact condition of the cells.

The system here described has power enough to handle 365,000 bells or lamps, which is a good deal more than it will ever be called upon to operate most probably.



The Potentiostat Can Ring 365,000 Call Bells or Signal Lamps, the Latter Being Used for Hospital Service.

The advantages of this new system are apparent when it is considered that the light will continue to burn as long as the call is not answered, and any delinquency on the part of the attendant will be readily noticeable by the undue length of time which the lamp operates. This device has proven its value repeatedly at various hospitals where it has been installed by increasing the quality of the service.

New Arc Lamp Consumes No Electrodes

This New Arc Lamp Marks the Greatest Advance in Illuminants in a Decade

SINCE the advent of the gas-filled incandescent lamp bulb, science has led us to believe that the only step remaining to make an ideal illuminating unit would be the invention of cold light. However,

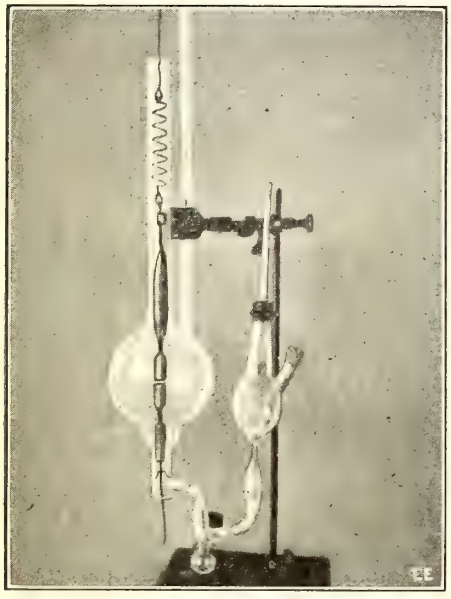


Fig. 1. Appearance of New Arc Lamp That Does Not Consume Electrodes.

there has appeared a new and novel arc light which burns in a gas-filled chamber. It may be remarked that the arc lamp was the first electric lamp of any practical importance.

This new lamp, the invention of W. A. Darrah, is the outcome of a series of elaborate and painstaking experiments on various forms of electrodes and different mixtures of gases in the chamber. In its present form it consists of two tungsten electrodes which are not consumed, and the arc burns in an atmosphere of certain gases. The lamp is shown in Fig. 1, and, as will be seen, comprises a glass bulb containing a predetermined amount of gas (a mixture of titanium tetrachloride and bromine gas), and having supported from the opposite ends the two tungsten electrodes.

The working parts of this lamp are indicated in Fig. 2, and the general idea of its operation can be obtained therefrom. The large glass bulb is approximately the size of an ordinary incandescent lamp and has mounted at the lower end a solid rod of tungsten ¼ inch in diameter. The connection to this rod is made through a small tungsten wire. The upper neck of the tube supports a sliding iron core in which is mounted the other tungsten electrode. A flexible conductor connects the upper electrode with the seal in the globe, and a coil of wire around the iron core (see diagram) of the upper electrode serves to start the arc and regulate same. This regulation is very easily accomplished, due to the fact that the electrodes are not consumed, and, being automatic, the lamp may be operated from an ordinary switch.

The effect of gases on the stability of an arc was determined by Poulsen in connection with his experiments with arcs for wireless telephony and undamped wave radio transmission. The same effect is here obtained by the gases used inside of the globe. They render the arc intensely luminous and very steady. The gases themselves are consumed at a very slow rate, and thus the globe is not blackened. The lamp requires no more attention than an ordinary incandescent bulb.

In operation this lamp gives an arc from 2 to 5 inches long, depending, of course, upon the voltage, and the arc proper is about ⅛ inch in diameter. It has the appearance of a bright, white incandescent filament. It does not flicker like an ordinary carbon arc in the air, and the intense light has a spectrum almost identical to that of the north sky on the afternoon of a clear day. In other words, this means that the lamp gives a light not unlike daylight, the only difference in the spectrum being due to the slight absorption of the various spectrum lines by the vapor in the lamp.

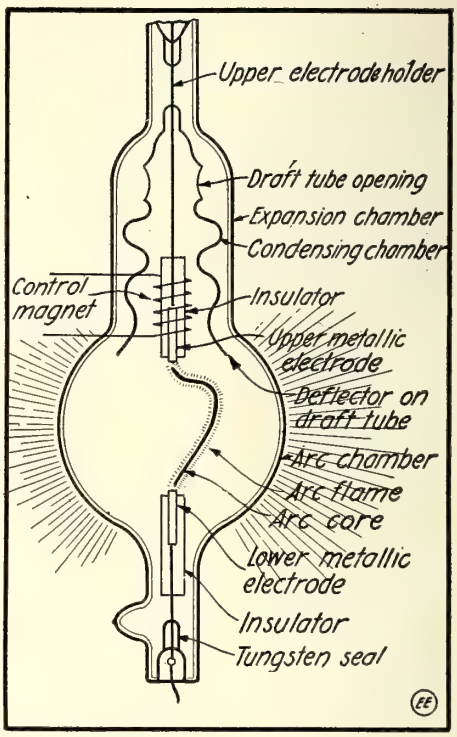


Fig. 2. Diagrammatic View of New Gas-Filled Arc Lamp, Which Seems to Possess Great Promise.

Although this arc lamp is still in more or less of an experimental stage, it gives considerable promise of supplanting the modern incandescent light and becoming a large factor in the illumination of the near future.

ELECTRIC MOTOR BUCKETS, THE LATEST.

Electric motors have been adapted to many diversified requirements in the industrial line, and it seems as though these



Fig. 1. Small Grab Bucket Opened and Closed by Electric Motor Mounted Directly on Same.

adaptations had come almost to an end, but every day there is found some new and worth-while application of the electric motor, which has so far remained unsurpassed for high operating efficiency, cleanliness and ease of control.

One of the latest uses of the electric motor is its incorporation in the design of large grab-buckets, as the illustrations herewith portray. Fig. 1 shows a large clam shell bucket suitable for scooping up coal, dirt, or other loose material, and the operator is seen plugging in the flexible cable leading down from the crane into the motor terminal block. As perceived, the motor operates the bucket jaws through the medium of a short, but powerful chain belt. The many advantages of this arrangement are self-evident, as any extended length of control cables or ropes which have caused immeasurable annoyances in the past are done away with. The motor in this case can be operated by the man in charge of the crane or derrick, to which the grab-bucket is attached or where the bucket is used in shops and manufacturing plants on a traveling rail, a short switch chain extending from the motor enables anyone to operate same with ease and dispatch.

Fig. 2 shows a powerful electric motor bucket equipped with steel teeth and intended for digging in hard materials, such as dirt mixed with rocks, etc. These newly devised buckets are supplied in a large variety of designs and special types are furnished whenever necessary. The flexible electric cable supplying the motor current, it may be mentioned, is wound up on a spring-propelled drum attached to the crane or derrick.

The many advantages accruing from this distinct and valuable advance in engineering design is at once apparent to anyone who has ever watched a grab-bucket at work. No end of trouble is encountered

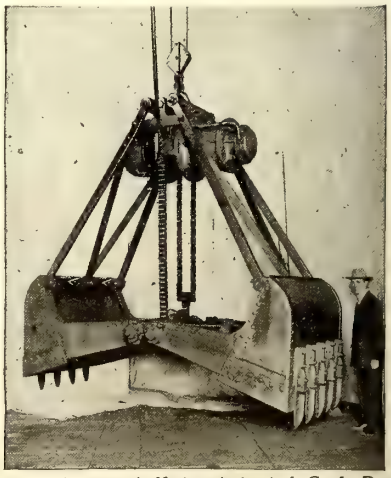


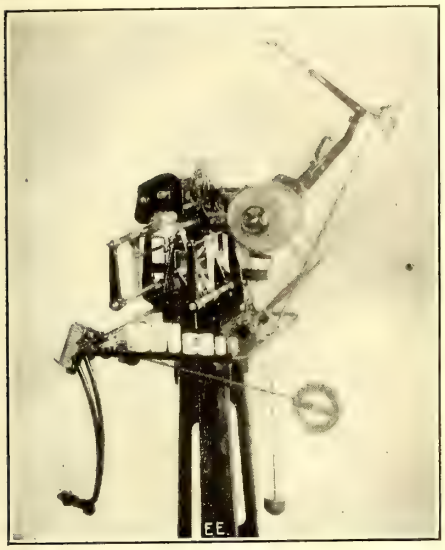
Fig. 2. Powerful Motor-Actuated Grab Bucket Fitted with Teeth.

regularly in the operation of cable-controlled buckets of this type. Again, they often fail to close fully, but not so with the motor-operated type, as it closes the jaws tightly every time.

A NOVEL ELECTRIC COIL WINDING MACHINE.

By Frank C. Perkins.

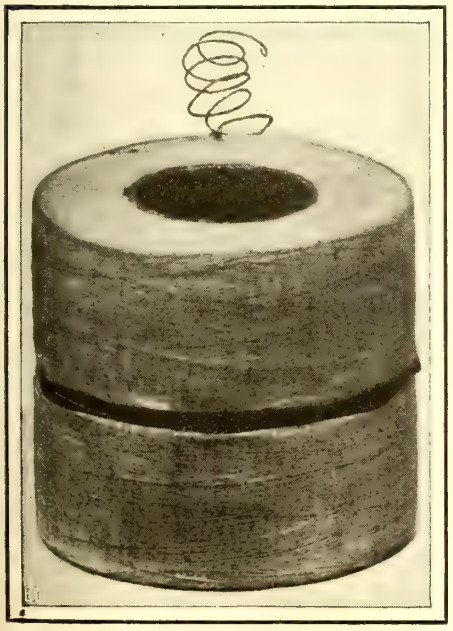
The accompanying illustration shows a novel electric coil winding machine developed at Boston, Mass. It occupies a floor space of 2 feet 6 inches by 2 feet 2 inches



Clever Machine That Automatically Crosswinds Magnet Coils of Self-Supporting Form.

and has a weight of 300 pounds. The driving pulley speed is 500 to 2,000 r.p.m. and it winds any length of coil. This electric coil machine is used for winding magnet coils by the Universal cross winding method, which has given excellent results in winding many forms of coils.

Valuable economic results have been secured through the use of the machine in winding coils automatically, in place of by hand or with somewhat crude mechanical appliances. It has been found that while for some kinds of magnets the cross-wound coil is admirably adapted, there are many forms of coil for which cross-winding is not adaptable. Experiments were begun in winding concentric coils, the wire being



Typical Crosswise Wound Coil, Made on Machine Above Pictured.

placed side by side similarly to spool thread. As will be obvious the difficulty with such coils arises from want of cohesion, without supporting heads. The element lacking was finally supplied by the addition of fine cotton yarn wound simultaneously with the wire, by the cross-wind system.

The coil thus produced is unique, and extensive use of this arrangement has demonstrated its value over the entire field of electrical magnets. The coils formed by the magnet machines are symmetrical, strong, compact and durable. These coils are wound either in cylindrical or in rectangular form, with or without cores. When wound without cores, they can be compressed into any desired shape without impairing their efficiency.

In winding this form of coil, a fine cotton yarn is interwoven with the wire, which may be either enameled or insulated with silk, cotton or other suitable material. The plane of the wire convolutions is at right angles to the axis of the coil, while the plane of the cotton strands lies obliquely to the axis, the entire mass being bound together so that the finished coil is practically indestructible either from external or internal stress.

In winding these coils the yarn is carried axially to a greater distance than the wire convolutions, thus forming an electrical and mechanical protection at both ends of the coil. After the requisite number of convolutions of wire have been made, the winding of the yarn may continue and entirely cover and surround the wire. The resulting coil is completely armored, similarly to a taped coil, rendering a separate covering operation unnecessary. In the winding process the yarn is so disposed that the convolutions of wire are slightly separated; and while a complete insulation between the several layers of wire is not obtained, there is secured a graded insulation which is thickest where the potential difference in voltage is highest.

It is stated that the amount of insulation may be varied, depending, naturally, upon the design of the coil. The interposing of the yarns between the layers and turns of wire facilitates the impregnation of the coils with the various insulating compounds. The mass of yarn between the layers and between the coils also forms a cushion, making an elastic coil, so that when high voltages or heavy currents are passed through, the coil is not ruptured or destroyed.

It has been found that the space factor is high and the air gap low, particularly so when this coil made of enameled wire is compared with coils wound with cotton or silk covered wire. In addition to the many electrical and mechanical advantages secured by this form of coil, a notable feature is the facility with which coils may be duplicated, giving exactly the same result in every coil wound. Coils wound as described have eliminated therefrom all defects, perfect units being produced.

It is of interest to note that the machine illustrated is automatic in operation. It is provided with a counter which can be set to the predetermined number of convolutions required, the machine stopping when these have been made, therefore insuring the same resistance and uniformity of size in all coils.

ELECTRICAL PRODUCTION OF OXYGEN AND HYDROGEN.

Oxygen and hydrogen are at present produced by two methods, viz., by the decomposition of potassium chlorate and manganese dioxide and by the decomposition of water by an electric current. The latter method is cheaper and a much purer gas is produced. The only substances needed for generating the gases is distilled water and a small quantity of potash for increasing the conductivity of the electrolyte.

Our photograph, Fig. 1, shows a commercial generator unit designed for generating the above mentioned gases. Each of these units is capable of delivering 3.2 cubic feet of oxygen and 6.4 cubic feet of hydrogen per mean hour and 4 cubic feet of oxygen and 8 cubic feet of hydrogen per kilowatt-hour.

These generators operate on 400 amperes at 2 volts D.C., or a little over one

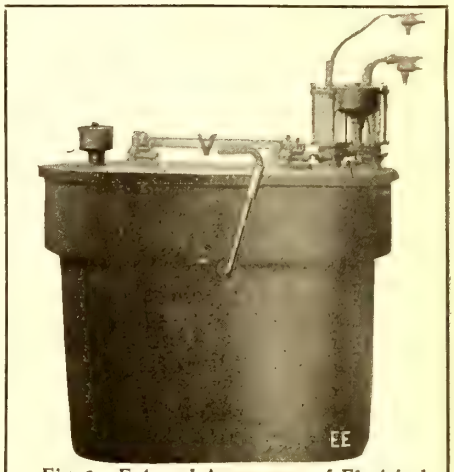


Fig. 1. External Appearance of Electrical Oxygen Generator.

horse-power of electrical energy. The gases are produced in compartments perfectly separated and, therefore, are very pure; the oxygen testing 99.6 per cent., while the hydrogen tests 99.8 per cent., which is undoubtedly pure enough for any use, even for medicinal work.

The generators are built entirely of iron. Fig. 2 depicts a schematic diagram of one of these units. At A is the oxygen off-take and at B the hydrogen off-take, which are connected to two separate glass tubes C, C, called the indicators and pressure equalizers. The negative terminal connects to the frame of the unit. The water is poured into the cell through cup F. In order that the gases do not escape into the air or mix up with each other within the cell, a hydraulic joint, G, is provided. The positive or anode pole is separated from the cathode by an asbestos dia-

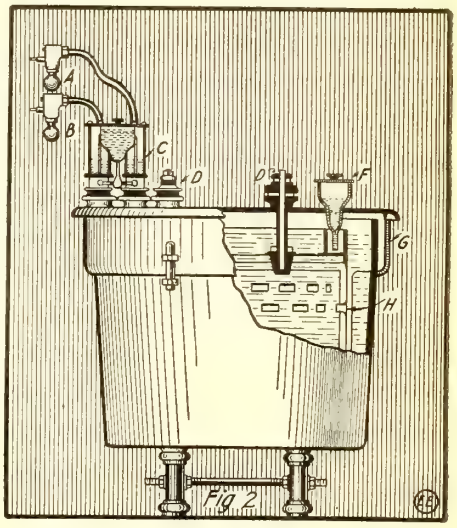


Fig. 2. Detailed View of Oxygen Generator.

phragm, H, which is porous. The complete unit is supported on porcelain insulators.

Photograph by courtesy of the International Oxygen Co., the builders of these unique generators.

Why not become a regular reader of *The Electrical Experimenter?* Subscribe to-day! It will cost you but $1. Do it *now.*

Mysteries of Matter

By John Candee Dean

WHAT do we actually know about matter today? What we partly know and what we do not know is covered at some length in the following discourse by Mr. John Candee Dean. Most of us have heard of or are somewhat familiar with the division of matter known as the atom. The electron is the latest sub-division of matter and an atom has been estimated to be 100,000 times as large as an electron. In order to bring the electron up to the size of Lord Kelvin's magnified atoms it would be necessary to magnify a drop of water to 100,000 times the size of the earth. Here is something to think about! For when all the peculiarities and characteristics governing the formation and activities of the electron are once known, then we shall be indeed a long way on the road to the solution of many scientific and industrial problems which at present have baffled our best technicians. The electron, according to the latest researches, apparently lives in a world all its own, which is as interesting in its study as the life of the average human.

IN the study of the vast, or of the minute, the imagination is incapable of comprehending the spaces involved. When we say that the sun is more than a million times larger than the earth, the statement does not present a mental picture of the sun's magnitude. A better conception of the sun's immensity can be obtained by saying that if the earth were placed in the center of a spherical shell, with a diameter equal to that of the sun, the moon's orbit would be a little more than half way between the earth and the shell of the sphere. But sizes of all things are relative. The magnitude of the sun is insignificant compared with some of the fixed stars. Professor Kapteyn estimates that the red star Antares, in the heart of the Scorpion, is 3,400 times as brilliant as the sun. The diameter of Antares is estimated to be 160 million miles, or nearly as great as the orbit of the earth.

We meet with the same difficulties in attempting to comprehend the spaces occupied by molecules, atoms and electrons. Lord Kelvin said that if we could magnify a drop of water to the size of the earth, the atoms then might appear to be somewhat smaller than cricket balls. The average atom has been estimated to be 100,000 times as large as the electron. Now to bring the electron up to the size of Kelvin's magnified atoms, it would be necessary to magnify a drop of water to 100,000 times the size of the earth.

For nearly 100 years Dalton's atom kept its place in the theory of the structure of matter. This atom was supposed to be the ultimate particle of matter, and stability was believed to be an essential characteristic of all the elements. At the beginning of the present century, the old theory of the indivisible atom, and of the stability of the elements, was upset by the discovery that certain rare elements were disintegrating, and changing, by throwing off particles much smaller than atoms. It must not be assumed that this discovery demolishes the atom. It does not. The atom continues to be the unit that enters into all chemical combinations. The hydrogen atom was formerly the smallest particle known to science. Now the smallest particle known to science is the electron, whose weight is one seventeen-hundredth part of the hydrogen atom.

Herbert Spencer said, in substance, that organic progress consists in a change from the homogeneous to the heterogeneous, and this law of progress is the law of all progress. He said, "From the earliest traceable cosmical changes, down to the latest results of civilization, we shall find that the transformation of the homogeneous into the heterogeneous is that in which progress consists." No two elements have atoms of the same size or weight, and each of the different elements has strong individual characteristics. Atoms are therefore heterogeneous, and according to Spencer's law they must have been evolved from a lower stage of matter. Now electrons appear to be absolutely homogeneous, since all electrons are of the same weight or mass, carry the same electric charge, and always turn out to be the same thing, regardless of the metal that forms the negative electrode, or the gas from which they are derived. Hence, according to the Spencerian law, they should be the primal substance from which matter is evolved.

Stability is no longer regarded as an essential characteristic of the elements. The element radium disintegrates by the explosion of its atoms. The primary elements subject to disintegration by atomic explosions are uranium, actinium and thorium. Radium is derived from uranium in consequence of its throwing off three atoms of helium. Hydrogen (1.008) is the lightest of the elements. Uranium is the heaviest. Its atom is 238.5 times as heavy as hydrogen. The atomic weight of helium is 4. Three atoms of helium would be 12, hence uranium (238.5) — helium (12) = radium (226.5). The atomic weight of radium is 226.4. The small difference is probably due to the loss of electrons during the change. Radium disintegrates by the breaking up of its atoms, each radium atom hurling off one particle of helium, and one of niton. The change is as follows: Radium (226.4) — helium (4) = niton (222.4). Therefore, the atomic weight of niton is 222.4.

The explosion of the atoms of radium appears to be as complete as that of a steam boiler; the whole of the atom bursts into gases. The light atoms of helium, that form, are shot into space with a velocity of more than 10,000 miles a second and the heavy residual atoms of niton acquire sufficient velocity, in consequence of the ejection of the helium, to escape and be deposited on bodies in the neighborhood. The expelled helium atoms are called Alpha rays. There is an inexpensive little instrument, called the Spinthariscope, which is arranged with a minute particle of radium in front of a zinc sulphide screen. On looking into the instrument one can see the helium atoms bombarding the screen, each atom producing a minute scintillation, the hundreds of points of light making the screen sparkle like the stars in the Milky Way. The helium atoms are so minute that the bombardment of the screen could go on for hundreds of years without any sensible diminution of the particle of radium.

Radium also emits powerful Beta rays, which consist of electrons flying out with a velocity of 100,000 miles a second, capable of penetrating thin plates of metal. A third radiation, called Gamma rays, originate in the impact of the Beta rays. They are really X-rays of such strength that shadow-graphs can be made with them through eight inches of solid lead. This radiating power is an automatic property which cannot be produced artificially. Radium is a very heavy metal. Heavier than gold, mercury, lead or any material with which we are familiar. It disintegrates very slowly. Its half period of decay is 1,760 years. If a gram of radium were put away for 1,760 years, only half a gram would remain at the end of that time; in 3,500 years one-fourth gram, and in 7,000 years one-eighth gram would remain. The half period of uranium is roughly estimated at seven billion years, while that of thorium, another radio-active element, at ten billion years. An attempt has been made to estimate the age of the earth from these slowly decaying elements.

As already stated, the emanation of radium is niton, an inert substance which forms no salts. Niton's half period of decay is only four days, and its emanation is changed to a new type of matter called Radium A. Each second a definite fraction of the number of atoms present break up, and the process of degeneration continues through a number of distinct unstable forms, called Radium A, B, C, D, E, F. Radium F is also called Polonium, an intensely radio-active substance with an atomic weight of 210.4. By throwing off one atom of helium its weight changes to a substance with an atomic weight of 206.4 which is close to that of lead, hence it is probable that lead is the final product of the radium series. Twenty-six so-called elements are derived from the automatic breaking up of uranium, thorium and actinium; 16 of which are formed by throwing off of helium atoms, and are therefore real elements. Ten are formed by the emission of electrons and therefore are allotropes or pseudo-elements. It is by the ejection of full-sized atoms that substances of different chemical properties and valency result. We frequently have our attention drawn to the enormous energy stored in radium and its emanations. Sir Wm. Ramsay states that the heat which niton parts with during its disintegration is equal to 3,500,000 times the energy available by the explosion of an equal volume of detonating gas. The principal part of this energy comes from the expulsion of helium atoms. He also says: "If radium were to evolve its stored-up energy at the same rate that gun-cotton does, we would have an undreamed of explosive, provided always that a sufficient supply of radium were forthcoming," and Sir J. J. Thomson startles us with the statement that the atomic energy stored in an ounce of chlorine, "Is about the amount of work required to keep the *Mauritania* going at full speed for a week." He further tells us that to split up an atom of one element into different kinds of atoms would involve enormous transformations of energy, "In fact the explosion of the atoms in a few pounds of material, might be sufficient to shatter a continent!"

The electromagnetic unit is an electric current of one ampere flowing for ten seconds. A 16 candle-power, 110 volt, carbon-filament, electric lamp requires a current

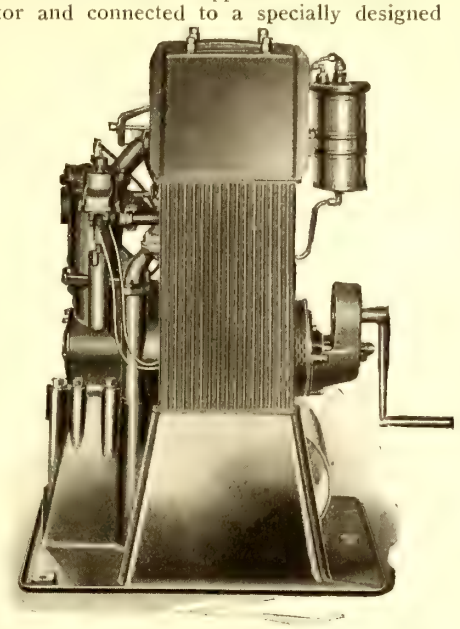
"UNI-LECTRIC" AN IDEAL PRIVATE LIGHTING SYSTEM.

A few years ago "private electric lighting plants" were rated as a luxury which only the very wealthy could enjoy. Now, however, the introduction of the "Uni-Lectric" lighting, cooking and power system has proved that not only is a complete electric lighting plant in domestic size available at a reasonable cost, but that it is available without the elaborate and complex mechanism of the ordinary individual electric system. Such being the case, it is expected that the "Uni-Lectric" will be the forerunner of a complete revolution in private lighting methods in communities where current from a central power station is not available.

The "Uni-Lectric" lighting system is a recent invention perfected by Warren Noble, well-known consulting engineer and designer. Its chief claim to distinction lies in the fact that the entire generating device is built in a single small and compact unit, 42 inches in height, 25 inches in length, and 24 inches in width. Hence the name "Uni-Lectric."

The device itself, which differs radically from anything else of the sort yet perfected, consists of a small four-stroke motor of the high efficiency type, operated by gasoline or other similar fuel, and direct-connected to a specially constructed electric generator. This generator develops a standard 110-volt direct current. It is cooled by a forced draft induced by fan blades on the flywheel of the motor, so that even when run for hours with an overload of 100 per cent. it will not overheat.

The fuel tank is supported above the motor and connected to a specially designed



The "Uni-Lectric" Lighting Plant is Very Rugged and Self-Contained, Comprising Dynamo and Gasoline Engine.

carbureter. The throttle is operated by a special electric governor regulating the speed according to the load and maintaining a constant voltage with all varying loads. The ignition is by high tension magneto with fixed spark.

No switchboard or batteries of any kind are used. No rheostat or volt meter is required. Two terminals are provided on the machine for attachment to the two feed wires leading to the lights. There is no possibility of misconnecting, as either wire may be attached to either terminal. The normal capacity of the machine is rated at 500 watts, with an overload capacity up to 600 or 800, so that from 30 to 60 Tungsten lights, depending on the wattage, may be carried on the line.

As designed the "Uni-Lectric" is said to be absolutely automatic and foolproof. It is started by a turn of the high-geared crank, and it is noteworthy that the starting gears are never in operation except when the handle is turned. The opening of the magneto switch stops the operation of the machine. All moving parts are inclosed. The motor and generator are so perfectly balanced that no foundation is required, and the machine need not even be bolted to the floor.

FRENCH DOG REPORTS BY TELEPHONE.

According to the *Gazette de France*, a certain French regiment possesses a dog which is sent out from advanced sentry posts at night with a telephone strapped over his mouth and a wire connecting the instrument with the post. If the dog hears the Germans approaching it barks quietly into the telephone.

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of one-half ampere. Therefore, such a lamp consumes one electromagnetic unit in 20 seconds. The agitation produced by the crowding together of millions of swiftly passing electrons gives rise to the brilliant light of the filament. The electric energy is so concentrated in the electrons that a mass of them equivalent to a mass of *one ounce* would light 300 of these lamps to their full candle-power, night and day, for a year.

In spite of the minuteness of atoms Rutherford has been able to detect the presence of a single atom of helium. He employed a partially exhausted vessel having a tiny hole, through which, by ingenious apparatus, single atoms of helium were shot. These atoms are expelled from radium with a velocity of more than 10,000 miles a second, striking and breaking up the gaseous molecules in the vessel, producing positively and negatively charged ions, which for an instant permit a current of electricity to pass. A current measuring instrument in the line records the entrance of the atom, enabling the observer to count each one as it enters.

We appear to be getting back to Franklin's single fluid theory of electricity. The electric current is believed to be a movement of negative electrons through a conductor, from the negative to the positive, instead of flowing from the positive to the negative, as was formerly supposed. Many scientists believe that negative electricity is the only kind. Positive electricity arises from a lack of electrons. For example, a positively charged helium atom is merely a helium atom that has temporarily lost two of its electrons. In theory the negative electron is not a particle negatively charged, but is in itself a negative charge. This is equivalent to saying that matter is wholly electrical. The electron enters into the structure of the atom, but is the weight of the atom due entirely to the mass of the electron? It is claimed that the electron has no mass in itself. Its apparent weight is due to the adhering ether which it drags along, as it shoots through space. It is like stirring a bucket of water with a cane, a small quantity of the fluid will temporarily adhere to the cane and be carried along with it.

Nature is more marvelous, more interesting and more beautiful than anything that the imagination can produce. The great French astronomer and scientist, Henri Poincaré, tells us that the scientist does not study nature because it is useful. He studies it because it pleases him, and it pleases him because it is beautiful. He says, "Were nature not beautiful, she would not be worth knowing, life would not be worth living. I do not mean here, of course, that beauty which impresses the senses, the beauty of qualities and appearances; not that I despise it—far from it; but that has naught to do with science; I mean that subtler beauty of the harmonious order of the parts which pure intellect appreciates."

It is a mistake to suppose that knowledge of breaking up of atoms into smaller particles originated with the discovery of radium. As far back as 1873 Sir Norman Lockyer suggested that many difficulties of the laboratory would vanish if we conceded that atoms could be broken up into much smaller particles. In 1890 he published "Inorganic Evolution as Studied by Spectral Analysis," in which he says, "Science now has to consider masses much smaller than the atom of hydrogen." In the study of the hottest stars he found himself in the presence of furnaces of transcendental temperature shielded by their vastness from the distracting phenomena which were present in the laboratory.

He classified the fixed stars in the order of their temperatures. Stars of the hottest class he called Argonian from the star Gamma of the constellation of Argo Navis, which has a temperature estimated by him at 50,000 degrees F. Gamma Argus contained a set of spectral lines not before recognized and he concluded that they indicated a new element connected with hydrogen. He called the new element protohydrogen, because of the relation of its lines to those of the proto-metallic lines. The Argonian stars are now called helium stars; they show but few elements. Protohydrogen, helium, asterium and proto-calcium are conspicuous. Lockyer tells us that the high temperature at which protohydrogen appears, is not the end of the simplification of stellar transcendental temperature. "The work of the dissociation of the atom carried on under our eyes in the hottest stars, is quite impossible in our laboratories." He says, "At higher temperatures the chemical units with which we work at low temperatures are broken up into smaller masses, explains the spectral phenomena observed, not only in our laboratories, but in the sun and stars. The final breaking up by heat must be the earliest chemical forms."

Heat is a motion of the atoms of matter, and a fall of temperature slows down this motion, but man's ingenuity has not yet brought a single atom to a state of rest. The temperature of a body varies as the square of the amplitude of vibration of its atoms. If all the heat of a body could be abstracted its atoms would cease to vibrate. Increase of heat accelerates atomic motion until a critical velocity is attained that overthrows the affinities which hold the atoms in chemical combinations. At a temperature of 4,000° F. the existence of water is no longer possible, not even in the form of steam. Its molecules no longer cohere, because of their energetic motion, and they dissociate into hydrogen and oxygen gases.

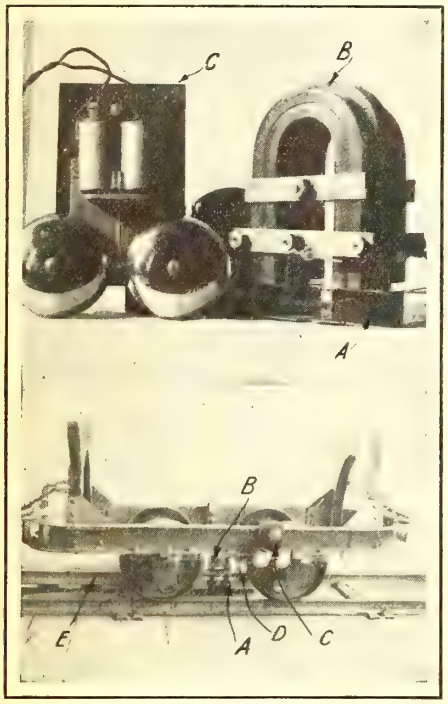
The heat of the sun is probably sufficient to dissociate all chemical combinations, consequently interior solar matter is in its monatomic, or elementary condition, and much of it may be in the electronic state. Perhaps there is a critical or maximum temperature for all matter, where the violence of the motion of clashing atoms causes them to break up into electrons. In stars of the highest temperature like Gamma Argus, or Zeta Puppis, the critical state has probably been reached and the greater part of their matter is in the form of electrons. When matter is in its hot-

(*Continued on page 590.*)

New Electric Signal for Locomotives

The subject of safety on railway trains is of vital importance, especially at present, when railroad travel is more extensive than it has ever been.

The main cause of accidents which arise now and then is due mainly to the negligence on the part of the engineer or switchman, and sometimes also to the improper working conditions of the semaphore. The cause is due to the engineer in that he does not watch carefully for signal blocks, although sometimes this is not rightly called the fault of the engineer, as it is often necessary for him to adjust some device in the locomotive cab while the train is in motion. Consequently his attention is drawn away from the road, which may mean a wreck or collision.



Above (Fig. 1): Shows Details of Magneto Ringer for Locomotive Signal. Below (Fig. 2): How Signal Bell Is Attached to Locomotive Frame.

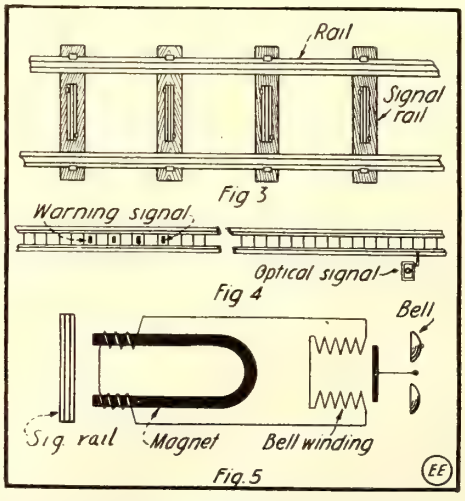
Suppose now a device is installed on the track before the block signal is reached, say about a mile or so, which, when the train reaches it, will cause a bell to ring in the cab, thus calling to the attention of the engineer that he is approaching a block and should be on the lookout for the signal which informs him of the condition of the road, of course.

Various devices have been developed in the past for arresting the attention of the man driving the locomotive, but none of them have proved a success, as they invariably employed contacts on the engine and track, and also some means of supplying current, such as batteries and dynamo. Now everyone knows that whenever batteries and sliding contacts in any electrical instruments are used that the condition of it will not be absolutely reliable. Practically all the devices for calling purposes on railways being employed to-day are impractical, due to the fact that they use sliding contacts and batteries or a generator, which require a great deal of care to keep the instrument in proper working condition and to which very little time can be given in railway work, generally speaking.

Now every student of electricity knows that whenever an electro-magnet is connected to a galvanometer and its field disturbed by some magnetic body, either by revolving same near the electro-magnet or by drawing it to and away from it, this action on the electro-magnet will cause a current of electricity to be produced in the winding, and this will in turn act upon the needle of a galvanometer. This is the exact principle upon which our present dynamos work.

This principle is used advantageously by A. Christian Berger (the originator and inventor of the submarine wireless system which was described in the August, 1915, issue of this journal) in developing a new electric railway signaling device, which employs only three simple parts and which does not, moreover, require any attention, as there are no sliding contacts or batteries used. His apparatus, which is shown in Fig. 1, consists of an electro-magnet A mounted on the poles of a powerful steel permanent magnet B. The electro-magnet is connected to an alternating current bell C (being of a type that does not employ any contacts), but which operates on the change of direction in the current.

The generating magnet A is placed underneath the locomotive as shown in Fig. 2, which is a photograph of an experimental train utilizing Mr. Berger's invention. The alternating current bell C is connected to magnet A by means of a wire D. The flux in the generator AB is changed by a series of iron strips E, laid between the track as perceived. In practise a number of short pieces of standard rails are laid in the center of the track and at right angles to it, as shown in Fig. 3, which is a schematic drawing of the track. The operation is as follows: When the train is passing over these intermittent center rails the magnetic flux in the electro-magnet is increased and decreased successively, thereby producing an alternating current in the coil, which in turn operates the polarized bell. The faster the train passes over these rails the stronger the bell will ring. If the number of rails is increased the same effect is produced. As will be seen, the operation is simple, neither contacts nor batteries are employed and there is nothing to wear out. The location of these rails would depend upon the condition of the roadbed. Fig. 4 shows diagrammatically the position in which they are placed. The connection of both of the instruments is depicted in Fig. 5.

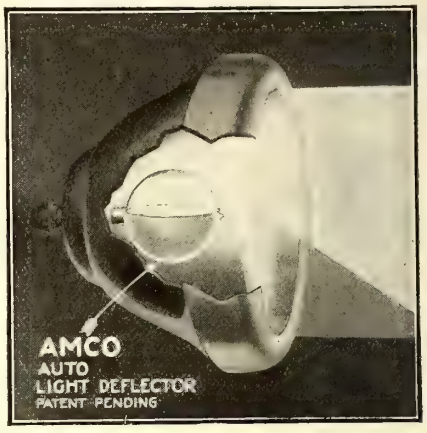


How the Berger Magneto Locomotive Signal Operates. Changes in Magnetism Ring Bell. No Battery Used.

This is another achievement in the development of apparatus for the prevention of accidents. "Safety first."

NEW AUTO HEAD-LAMP REFLECTOR.

The blinding glare produced by automobile headlights has been the subject of much discussion and legal argument. In some cases there have been passed ordinances controlling this problem. To reduce the blinding glare so produced, which has been the cause of many otherwise avoidable accidents, there has been recently marketed a unique device shown in the accompanying illustration. This consists of a hemi-spherical shell enameled white inside, which readily snaps over the electric light bulb in any such headlight. Its function is to deflect all the light rays to the upper half of the lamp reflector, thus throwing them outward and downward. It is guaranteed to meet the requirements of all State laws and regulations, and has received official sanction by the department of motor vehicles for the State of New Jersey. It should find general and extended use by all motorists, as the price is very nominal indeed, and as is generally known, the owner of a motor car does not care to spend any more than is absolutely necessary on such attachments as these.



Novel Auto Head-Lamp Shield to Reduce Glare.

ARMY PURSUES BANDITS WITH WIRELESS.

With the arrival at Mission, Texas, of Company B, Signal Corps, from Texas City, the American border patrol forces in the Lower Rio Grande Valley were able to pursue bandit raiders with the aid of wireless, it was announced at Fort Sam Houston.

Company B has four sets of portable wireless telegraph outfits, and there are already three pack trains in the Brownsville district. This will make it possible for Colonel Blocksom, commanding the district, to station one detachment of the signal company with a wireless outfit at Mission, the operating center of recent trouble, and have three detachments, each with wireless and pack train detail, ready for immediate field service.

The advantages of the new system of communication can hardly be estimated. Wire service, both telephone and telegraph, in the district is quite limited and even this has been often disabled by the raiders, who cut all wires as a preliminary to attacking any section. The result has been that while there have been an abundance of troops in the field for several weeks, they have been unable to surround a single band of raiders and prevent their escape because of the lack of communication and the densely brushy character of the country.

Do you know of some interesting electrical device, appliance or machine in your vicinity? Why not send us a picture of it?

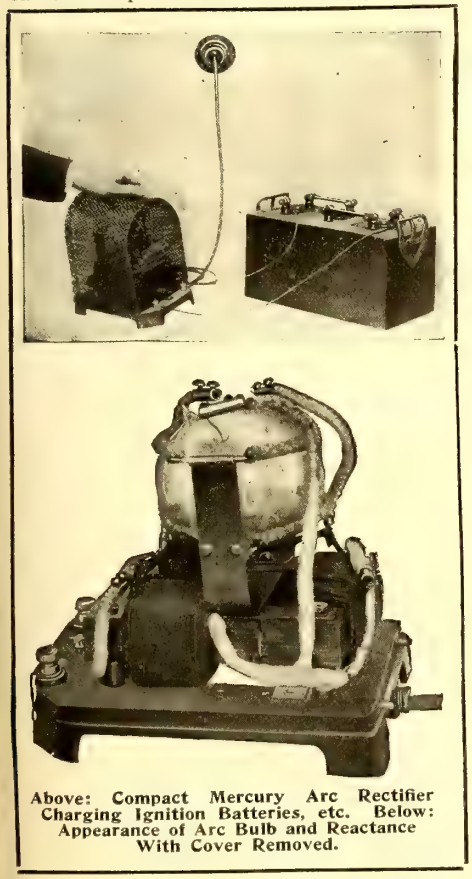
MERCURY ARC RECTIFIER FOR CHARGING SMALL BATTERIES.

A new and inexpensive mercury arc rectifier is just being marketed by one of the large electrical manufacturers for charging small storage batteries, such as those commonly used for starting, lighting and ignition current in gasoline automobiles and motor boats, for operating electric bells, for electro-plating and for numerous other uses where not over 5 amperes, 15 volts direct current is required and where only alternating current is available.

The new rectifier consists of a metal base, on which are mounted the necessary reactance coils and the rectifier tube in a suitable cover, the whole being encased in perforated sheet metal. It is designed for charging one three-cell, one six-cell or two three-cell batteries as required, and is automatic in that it is self-adjusting to any of these three conditions. In fact, the rectifier may be connected to a single-cell battery and will charge it at the rate of approximately 6 amperes from 110-volt alternating-current supply.

This type of rectifier is furnished for 60, 50, 40, 30 or 25 cycles, 110-volt alternating-current circuits. It is exceedingly compact, the outside dimensions being, roughly: Width, 6½ inches; depth, 9½ inches, and height, 11 inches. The total weight of the 60-cycle rectifier is approximately 15 pounds; therefore it may be transported from place to place in a garage, rendering unnecessary the removal of the battery from the car.

The rectifier is completely self-contained and requires no mechanical ability either to install or operate it. It is so designed that it will maintain a fairly constant current as the voltage of the battery rises. It is very easily started, simply by screwing the flexible lead attaching plug with which it is furnished into any convenient alternating-current lamp socket and connecting the two



Above: Compact Mercury Arc Rectifier Charging Ignition Batteries, etc. Below: Appearance of Arc Bulb and Reactance With Cover Removed.

binding posts, distinctly marked plus (+) and minus (—), to the corresponding terminals of the storage battery to be charged.

After the alternating-current supply has been turned on by the socket switch the rectifier is tipped slightly by means of the handle on the top. The mercury "arc" will then start, alternating current will be converted into direct current, the battery will begin charging and the apparatus requires no further attention until the battery is entirely charged.

The cost of charging either a 12-volt (six cell) or two 6-volt (two three-cell) batteries for a 10-hour charge is about 13 cents, or the same for a single 6-volt battery. This cost is based on a rate of 10 cents per kilowatt-hour for current. Where the rate is less, the charging cost will naturally be proportionately lower. This cost is exceptionally small when compared with the usual cost of at least 50 cents for charging a 6-volt battery and 75 cents for a 12-volt battery, and there is the added convenience of being able to charge on the ground. This rectifier should thus become very popular with public and private garages where only a few batteries are to be charged.

Automobile Storage Batteries Withstand Fire

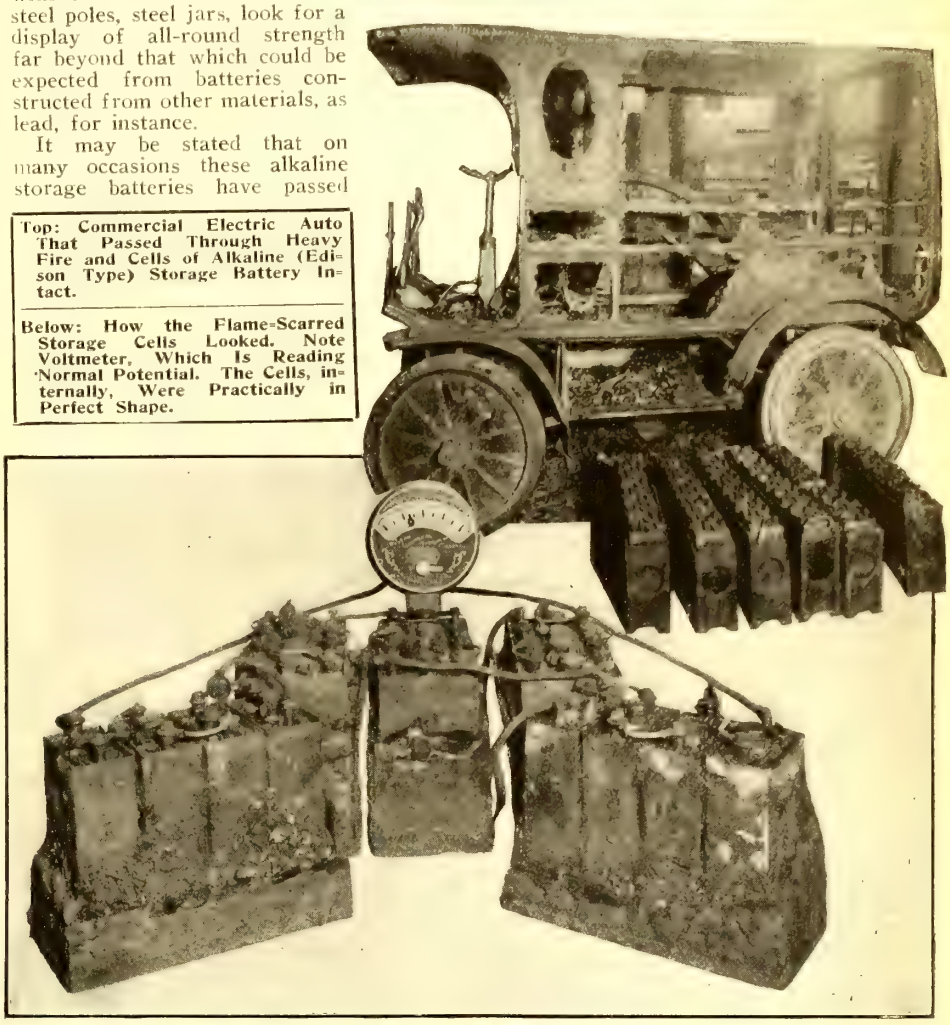
By Frank C. Perkins

THE accompanying illustrations show the result of a severe test of an automobile storage battery under most abnormal conditions, and proves that Edison storage batteries are most rugged. Those who use them and are acquainted with their steel construction, steel plates, steel poles, steel jars, look for a display of all-round strength far beyond that which could be expected from batteries constructed from other materials, as lead, for instance.

It may be stated that on many occasions these alkaline storage batteries have passed through fires that have completely burned the wooden trays in which they were assembled, and which have even melted some of the hard rubber insulation. Capacity for such abuse has never been chronicled in storage battery history until the advent of this cell. Many of these experiences have resulted in only a temporary decrease in efficiency instead of complete annihilation, and after making a few necessary repairs the battery has been returned to work better than new. One instance of this was a fire in Indianapolis, a short time ago, that burned a garage to the ground. The next morning the "electric" was run from the ruins on power supplied from its batteries, even though the body of the car was burned and the wooden trays in which the cells were assembled were badly charred.

When the garage of the Electric Light Co. of Cambridge, Mass., was burned and its contents practically destroyed, the remains of one alkaline battery-equipped truck were still serviceable and, with the exception of two cells in this Edison battery, none were beyond repair; in fact, practically nothing had to be done except insert new rubber parts when the cells were recanned.

It is said that all of the bushings and hard rubber insulators of the battery were totally destroyed. However, the connectors had not become loose and there was sufficient charred insulation in place to permit a test. Twenty of these cells when so tested showed an average of 1.3 volts, and the current available in the battery was sufficient to turn a No. 14 wire red hot in a few seconds.

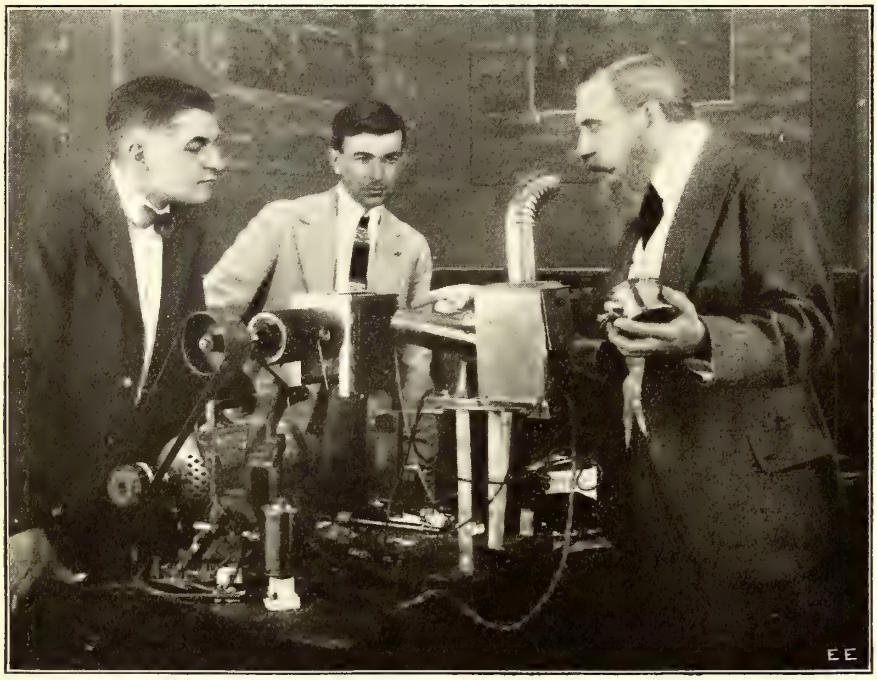


Top: Commercial Electric Auto That Passed Through Heavy Fire and Cells of Alkaline (Edison Type) Storage Battery Intact.

Below: How the Flame-Scarred Storage Cells Looked. Note Voltmeter, Which Is Reading Normal Potential. The Cells, internally, Were Practically in Perfect Shape.

A Telephotograph in the "Movies"

The wide-awake spirit permeating the motion picture of to-day is strongly exemplified in one of the late Pathé films illustrating the episode, "The Disappearing Helmets," from the story of the "Romance of Elaine." The photograph reproduced herewith shows one of the leading characters in this extremely interesting film story, known as Prof. Arnold.



Exciting Movie Scene in Pathe Film, When Prof. Arnold Makes Use of the "Telephotograph."

He is here observed making good use of one of the latest developments of science, or the "Telephotograph," the machine that transmits and reproduces a photograph over a wire.

The film views showing this apparatus in operation are particularly well arranged, especially with respect to the color scheme in the original reproduction.

The photographs transmitted and reproduced over the telephotographic apparatus are, as is generally known, made up of a series of parallel lines closely spaced, and these lines, by their variation in thickness, etc., enable the reproduction of a built-up sketch of photograph. It is now possible to do this work in the laboratory (Dr. Korn's method); but as yet practically no commercial applications have been made, at least in this country, of this remarkable scientific achievement.

Photographs were transmitted over a wire circuit 500 miles in length, between Monaco, Italy, and Paris, France, for use in a Paris daily newspaper several years ago, utilizing Dr. Korn's system.

UNCLE SAM SILENCES TWO AMATEUR WIRELESS PLANTS.

Amateur wireless telegraph operators in the Great Lakes district have been under secret surveillance by officials of the United States Government.

Two licenses have been suspended, nominally because the equipment exceeded in power and sending capacity that permitted by Federal statutes.

One of these suspended stations was in Wilmette, within easy range of the big Government towers at the Great Lakes Naval Training Station, to which are sent many secret dispatches governing army and naval affairs.

No confirmation could be obtained from the Federal radio inspector's office as to whether this activity followed the persistent reports along the north shore than Government officials were investigating persons suspected of being spies for foreign governments.

It was declared that the instrument used by Charles A. Burgy, Jr., in Wilmette had a working radius of 75 miles and used a wave more than 340 meters in length, whereas the greatest permitted to amateurs is 200 meters.

The license of John D. Speicher, 4155 Grand boulevard, was revoked because his instrument also exceeded the limit.

"If these amateur instruments are allowed to operate without restriction," said Charles Blankenship, the Chicago radio inspector, "they will grow to a point where they might interfere seriously with Government regulation.

"Also, suppose a ship on the lake got into trouble and started an 'S-O-S' call for help. Then let one of these powerful instruments try to send at the same time. The usefulness of the ship's instrument might be available for only a few minutes, and disaster follow.

"We have checked up on many of these instruments. We will get after the others at once. Amateurs should understand that it is a dangerous proceeding to violate the statutes."

Especial attention is to be paid the operators who complete their message by any of these signs:

9 CT	9 YH	9 KS
9 OW	9 JP	LW

Complaints have been made that all of them exceed Federal regulations. Several other operators, unlicensed, whose messages have been caught and reported, are being searched for.

SOMETHING NEW IN ELECTRIC WASHERS.

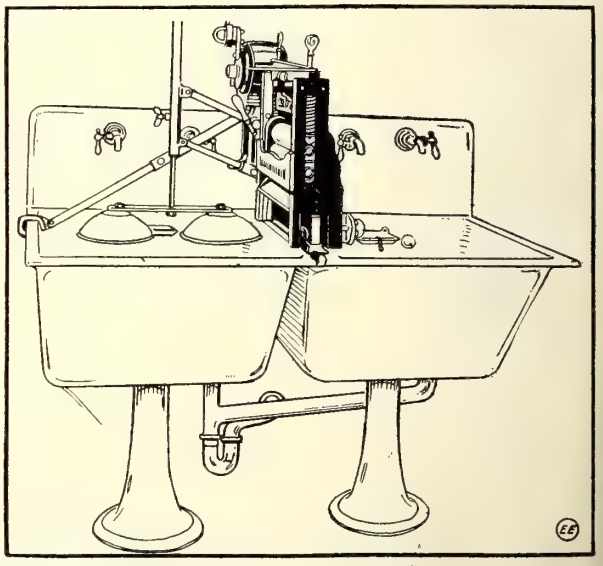
By Frank C. Perkins.

The accompanying drawing shows an effective electric washing machine embodying many new and radically different features, developed at Los Angeles, Cal. This machine washes, wrings, rinses and blues in any stationary tub and eliminates all handling of water by the operator—the plumbing fills and empties the tub for her. Being mounted on the stationary tub, the machine is entirely out of the way; yet it is always ready for use, and avoids all "getting ready" and "putting away."

It is of interest to note that the well-known vacuum principle of washing is utilized. The smooth vacuum cups wash clean, clear through, without injury to the fabric, and anything from the most delicate and sheerest laces to rag-rugs, heavy bedding or blankets can be washed without tearing. The operation is extremely simple. One operating handle, by a slight movement one way or the other, governs the action of the wringer or washer.

To reverse the wringer the electric motor is reversed by means of an ingenious four-point attachment plug. This reversing it electrically instead of mechanically eliminates the complicated gearing otherwise required. Safety of operation is provided for by enclosing the mechanism; by a safety pressure release on the wringer, whereby pressure can be instantly removed from the wringer rolls, and by the four-point attachment plug, which may be quickly detached, stopping the washer or wringer immediately.

This electric washer has a worm-and-gear mechanism, running in ball bearings, with ample lubrication, which reduces friction and wear to a minimum. By loosening a thumbscrew the motor may be removed for other purposes. Simple accessories facilitate its use as a sewing-machine motor, or to operate small grinding or buffing wheels and save the cost of the additional motor usually required with such apparatus.



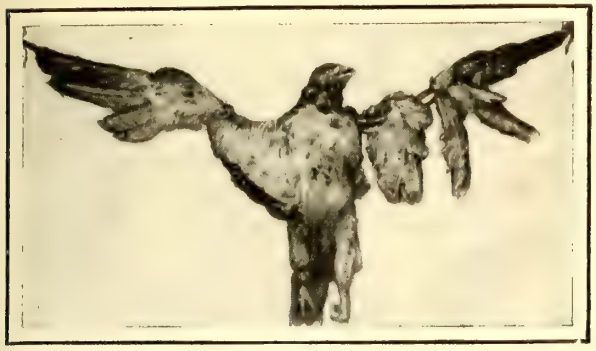
Ingenious Electrical Washer and Wringer, With Detachable Motor. The Outfit Fits Any Tub.

WIRELESS PLANT AT COOS BAY, ORE., ASSURED.

The removal of the Government wireless station at Cape Blanco to Coal Bank Inlet, near the entrance to Coos Bay, has been assured with the announcement that a five-acre site had been purchased by the Marshfield (Ore.) Chamber of Commerce. The site will be deeded to the Government.

HAWK GROUNDS ELECTRICAL TRANSMISSION LINE.

The illustration herewith shows the remains of a common hawk which some time ago flew into eternity through the transmission lines of the Public Light & Power Co., of Chattanooga, Tenn., near the lock and dam on the Tennessee River. During a storm in the valley of the Tennessee River the hawk, which measures five feet from tip to tip of his wings, either flew into the circuit or, alighting on one phase, stretched his wings, making contact with one phase and the ground wire, which is three feet from the nearest phase.



Hawk That Grounded High Tension Wires Besides Causing Its Death.

The line in question operates at 44000 volts, and it cost the company approximately $15 to remedy the trouble after it was located. Occurrences of this kind, while common in some sections of the country, are rather rare in the Tennessee River valley, but no matter where they occur they are beyond the control of transmission companies, a fact oftentimes lost sight of by the general public, which may be temporarily inconvenienced because of the failure of a transmission circuit from such cause. Some years ago a similar case occurred on a Western high-tension transmission line, in which a bobcat played the leading rôle. Being chased the animal took refuge in the high voltage line and, needless to say, he got the surprise of his life. One blinding flash announced the grand finale of his existence.

NEW RADIO SECRECY SCHEME TRIED BY U. S. NAVY.

Sending of radiograms by vessels at sea without revealing even the approximate location of the ship dispatching the message —a problem which has confronted naval strategists since the discovery of wireless communcation—virtually has been accomplished. Experiments of that order made by the "enemy" divisions of the Atlantic fleet during the recent war game were said by naval officials recently to have been highly satisfactory.

During the time the two forces were engaged in the maneuvers, one moving to attack the coast and the other to defend it, the vessels were in constant communication with the navy yards and supply stations ashore, but neither force was able to determine the location of the other by the use of the wireless.

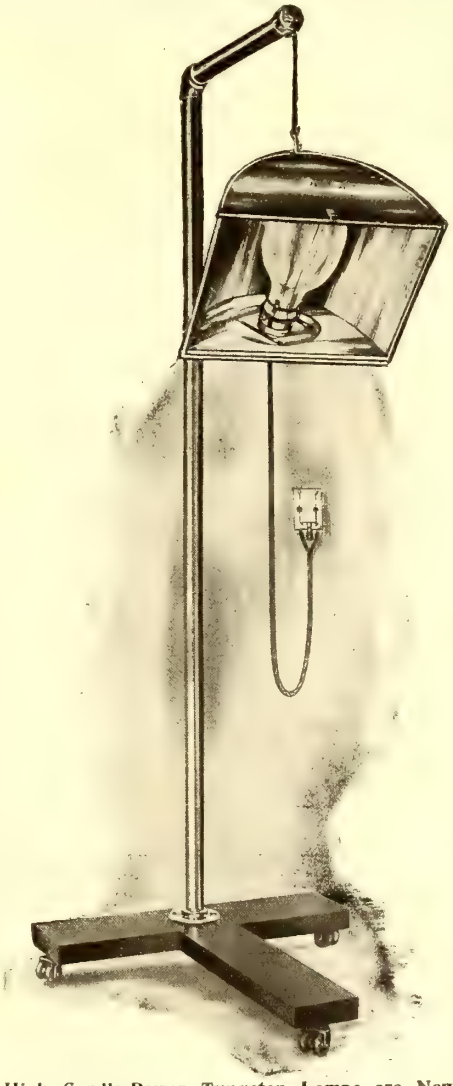
The messages were disguised by means known only to the Navy Department, and, for the first time in the history of the war game maneuvers they gave the vessels intercepting them no indication as to where they came from or what force of wave length had been used in transmission.

Ordinarily, naval officers say, an experienced operator can estimate the location or proximity of a vessel by listening in or receiving messages it is sending.

LARGE TUNGSTEN LAMPS USED FOR ELECTRO-MEDICAL TREATMENT.

The illustration presented herewith shows the arrangement of a large-size electro-therapeutical treatment lamp comprising a high candlepower tungsten lamp, which consumes from 500 to 1,000 watts. The lamp comes mounted in a suitable reflector. A flexible cord and plug connection is supplied with the lamp for insertion in a wall pocket. The reflector and lamp may be moved up or down to any required height by a specially arranged balancing scheme, the weight for which slides within the hollow upright standard, which is in turn mounted on a substantial pedestal. The pedestal is suitably mounted on casters so as to permit moving the treatment lamp about as required.

It has lately been found that treatment by the rays given forth by such a high candlepower lamp is of great value for certain diseases and ailments, and this form of treatment is being extended more and more every day as its efficacious properties become more widely known to the medical profession.

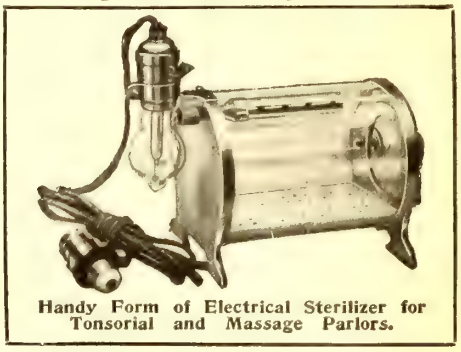


High Candle-Power Tungsten Lamps are Now Widely Used for Heat and Ultra-Violet Ray Treatment by Physicians. Adjusts to Any Position.

Their effects are not unlike the effects from sunbaths, in fact they really take the place of the sun for all practical purposes in the treatment of skin diseases.

ELECTRIC STERILIZER SOLVES MANY PROBLEMS.

A new electric sterilizer has been recently put on the market by a New York concern. This new sterilizer is herewith shown and consists of a gas-tight cylinder made of glass. A door is provided on one end, as perceived, and is supplied with a rubber gasket for making it absolutely air-tight when it is closed.



Handy Form of Electrical Sterilizer for Tonsorial and Massage Parlors.

The vaporizer, which is enclosed in the glass chamber, as seen on the upper left hand corner of the apparatus, consists of a glass bulb made similarly to an incandescent electric lamp, but it contains two wires, which are not connected to each other and thereby form two entirely distinct electrodes. These are immersed in a liquid which forms the electrolyte between the two electrodes.

A small hole is provided on one side of this bulb, into which the liquid is poured and whereby the gas escapes when the electrolyte is decomposed by the electric current. The liquid used in this vaporizer is so made that when it is decomposed it liberates a gas which is highly germicidal and consequently kills any germs that it attacks. The apparatus is a complete unit by itself and can be readily removed by unscrewing it from the screw socket as depicted.

This electro-formalin sterilizer is very efficient and it will undoubtedly find its way into hospitals and especially into dental laboratories, where surgical instruments are in constant use. It can also be used in the home for sterilizing rubber goods, such as babies' nipples, etc., and other various things which need constant sterilizing.

HAWKEYE RADIO ASSOCIATION OF LAMONI, IOWA.

The Hawkeye Radio Association held its annual convention on Sept. 1 and 2 at Engineering Hall, Iowa State College, at Ames. Officers for the year 1915-1916 were elected as follows: President, Ralph Batcher; secretary, Arthur B. Church; treasurer, Hollis Sels. After the general business was finished several talks were given by the new officers and club members, in which some very interesting suggestions were offered. A large assortment of apparatus from various companies was on display and tried out, several new instruments giving remarkable results, especially the new amplifying receivers but recently placed on the market. The convention adjourned with its members feeling highly satisfied with the good time they had had and the large amount of information collected. All wireless operators in Iowa should not fail to join this association, as the use of the club's testing instruments alone is worth more than the entrance fee. Communication with similar organizations is invited. Address the Secretary, Arthur B. Church, Lamoni, Iowa.

The housewife would appreciate an electric iron more than the vote. Take a hint Mr. Man.

The Shirikari Tentacle

By George Frederic Stratton

TWENTY-FOUR hours after the marvelous Poniatowski Ray had put the Japo-Chinese fleet in Cisneros Bay out of commission, Cawthorne, the young millionaire who had backed the inventor with both money and enthusiasm, was on a special train going north. With him was Kilroth, his mechanician, and between the only passenger coach and the locomotive was a box car containing two of the Poniatowski projectors which they were taking to install on one of Admiral Sorensby's vessels in San Diego Bay.

They had crossed the Arizona border at Nogales and there saw the first American newspaper they had seen since they had operated the new Gravitation Nullifiers on the Mexican side of the Rio Grande. And what they now read was as amazingly startling as any of their own exploits had been.

ADMIRAL SORENSBY'S FLEET ATTACKED BY SOME MYSTERIOUS AND UNSEEN FOE

Submarines Crippled and Battleships Thrown Into Confusion.

CONSTERNATION IN WASHINGTON

(*Special to The Nogales Star.*)

WASHINGTON, Aug. 10.—Information has just been wired to the Secretary of the Navy that during the last twenty-four hours three submarines cruising in San Diego Bay have come to the surface and displayed distress signals. Upon help reaching them it was reported that the boats and equipment had suddenly become charged with an electric current so powerful as to cause severe shocks to the crew when they came in contact with any metal. Two of the men on the S-3 were killed outright. On all three boats this astounding attack of uncontrolled electricity burned out the motor armatures, disabling the boats.

The battleship Idaho felt the same mysterious influence. For fifteen minutes she was practically out of control, because of the helplessness of the crew. Her wireless antenna and equipment was instantly burned out. Then the shock left as suddenly as it had occurred.

The weather was perfectly clear, no atmospheric disturbance being evident, and it seems impossible that any action by the enemy could have caused the trouble, as although the reserve Japo-Chinese fleet is on its way across the Pacific it is known by scout-aeros that it is over a thousand miles away. There is not a submarine in the Bay except those under Admiral Sorensby's command, and no aeroplanes have been seen for ten days.

Ned Cawthorne read the account a second time and then muttered to Kilroth: "What do you make of it, Billy?"

The inventor-machinist had no answer ready. His eyes dwindled to pin-points and peered vacantly at the big mogul which was backing down to couple onto their cars. After a pause he shook his head and grunted:

"It's beyond me, Cawthorne. Looks as if they'd been connected up to some very high-voltage current—but, how? No attempt to send a high-power current by wireless has yet succeeded."

"Humph! How about that Hammond torpedo boat? That's been doing wonderful work under wireless control, Kilroth. And the Japs tried, before the war, to buy all information and plans."

"It's wireless control only, Cawthorne. It carries its own power with it and, more than that, it's not a submarine. It operates in plain sight. Nothing of that type can be in San Diego Bay. There's some new scheme afoot, or afloat; but I haven't the faintest glimmer of an idea what it can be!"

* * * * * * * *

When they reached the Bay they found that the consternation had increased tremendously. A large number of the forty submarines were tied up with burnt-out motors; among them were six of the Cawthorne Omegon vapor boats which had so successfully attacked the enemy's dreadnoughts outside San Francisco.

Cawthorne and Kilroth were ordered to the flagship to consult with the Admiral on the disposition of the Poniatowski tubes, and while on board they had a full demonstration of the mysterious current. They were in the Admiral's cabin when a report came over the bridge telephone:

"Admiral! The ship is electrified. The men are——" Then with a crash in the receiver the communication stopped.

They rushed out to the main deck and saw officers and crew carefully avoiding any contact of their hands with any metal. Cawthorne placed his hand on a steel guy as he hurriedly passed it and instantly fell to the deck severely shocked. The vessel was at anchor and in smooth water, so that no orders for immediate operation were necessary.

Round the side of the turrets laid five deck hands dead. They had been swabbing down the deck and were in bare feet, which exposed them to the full force of the mysterious current when they had come in contact with the turret. Cawthorne had regained his feet, assisted by one of the officers, and, shaking in every fiber, glanced about him. Men were crouching strictly aloof from any article except the deck on which they were standing, and evidently too terrified to make any movement. The Admiral stood grasping the hempen falls of a boat tackle and listening to the report of the deck officer.

"The conditions are exactly the same, sir, as have been reported from other ships. It is impossible to handle any equipment of metal. In the engine room the stokers are crouched on the coal. It would take a winch and tackle to draw them off that."

The bewilderment, indignation and disgust on the Admiral's face were supreme. "Signal the *Minnesota* to send her diving crew and outfit over here at once! Let their launch lay away from the ship and the diver search below and around for any indication of concealed wires or torpedoes!"

The officer hesitated. "Our wireless is destroyed, Admiral! We shall have to use flag signals."

"Do so, sir. Stay! Is it possible to operate that starboard launch?"

The officer cautiously looked over the rail at the launch moored at the end of the boat-boom and hailed a man aboard her:

"Below there! Are you feeling any of the current among your machinery?"

"No, sir. None at all."

Lieutenant Barlow turned to the Admiral. "She can be sent away, sir, if we can get a crew aboard. But no man can reach her by the ladder."

"Hoist a man over the rail by a tackle!" commanded Sorensby. "Drop him in the water and he'll probably be safe from the current and can reach the launch. Two men can handle her."

This was gingerly and very deliberately done and in a few minutes the launch motor was started and the boat darted away to the *Minnesota* with the Admiral's order.

But before she had covered half the distance the strange electric current left the ship. In a moment everything was in its normal condition and, responding to a sharp order, deck hands were carrying the dead men below. Then again came the shock, tumbling men to the decks—some never to rise again. This time the Admiral, ascending the ladder to the bridge, was plunged down severely bruised and shaken.

The second attack lasted less than a minute, but the demoralization it caused was complete. Had one of the enemy's vessels appeared at that minute—even an unarmored collier—no offensive action could have been taken against her. Not a single gun could have been operated or fired.

* * * * * * * *

Two of the speediest light cruisers were to receive and operate the Poniatowski ray projectors, and on the day following the attack on the flagship Cawthorne and Kilroth had superintended the loading of the tubes onto a barge. As they steamed out to the cruisers they gazed at the group of great dreadnoughts lying at various anchorages, faint streams of smoke lazily curling from the funnels.

"There's a vessel apparently aground over there!" exclaimed Kilroth. "I noticed her yesterday. She's not one of the fleet, I guess. Looks like a tramp freighter."

"That's what she is, sir!" exclaimed one of the barge hands. "The *Aratusa*, from Manila to San Francisco. She went aground on the Chulavis Bar a week ago with a cargo of sugar. They say she's waiting for lighters."

They ran alongside the cruiser *Trenton* and hoisting tackle was rigged to transfer the big twenty-four-foot ray tube. It was hoisted above the deck and the hands were swinging the derrick around previous to lowering when the appalling current again attacked the vessel. Ropes were dropped as men recoiled in horror. At the winch the attendant at the gear clutch shrieked as he dropped away from the lever, and the winch, still operating without control, ran the great aluminum tube up against the

IN this remarkable story Mr. Stratton shows how a Dreadnought is put out of action by means of a certain electric current directed to the ship by an enemy. If this story does not sound plausible to you, because of the feature where the electric current is sent to the metallic hull of the ship, which would apparently short-circuit with the ocean, kindly consider this: The body of an electric eel is a first class conductor, so is the water in which the fish lives. Nevertheless the fish without killing itself, can kill a horse, if it touches the latter in a vital spot. Although the fish, the water and the horse are "short-circuited," the current sent from the fish is able to kill the horse, without harming itself. Our most able electricians have as yet not solved this apparent paradox.

collar of the derrick boom. Kilroth saw what would happen and sprang to the clutch lever, but was thrown as he grasped it, and the next instant a ripping, tearing crash accompanied the smashing away of the collar and the ray tube slipped down

But on the barge one discovery had been made. Jake O'Shea, a deck hand, who had jumped from the cruiser, had gone deeper than he expected and as he came up and swam to the barge a fine wire was twisted around him. It was about fifty feet long

treatment he had once revived for a few moments and gasped: *"The Tentacle! The electric Tentacle!"* and had then again lost consciousness. Whether he really knew anything of such a contrivance or had become obsessed or perhaps insane over the



" * * * Tiny Submarines * * * They Run Out with a Fine Composite Wire Cable, Through Which They Are Directed and Through Which That Current Is Shot After They Fasten Onto Their Prey * * * "

onto the ship's rail and from there into the water, instantly going to the bottom.

The *Trenton* sustained the longest attack of any vessel of the fleet up to that time. When the current went off she was practically out of commission. Except that her wireless equipment and all her motors were burned out, she had sustained no damage, but her crew was uncontrollably frantic. The cap of the rail was of wood and half of the men had vaulted over that into the ocean and swam to the barge, which had cast off her lines and drifted away. Of the other half several had been killed outright; others were so severely shocked as to be almost incapable of action or reason.

Flag signals reported the calamity to the Admiral, who signaled back: "Send the barge ashore immediately with orders to unload the other projector and store it in safety!"

Cawthorne breathed a great sigh of relief as he heard that order. Although he growled to Kilroth: "This is the first time that one of our devices has had to beat a retreat!" he cheerily said to the Captain:

"That tube will operate just as effectively from the land as from a vessel. She'll project that ray for twenty miles and that'll catch any enemy that comes into the bay."

"What if that unknown electric current should get into operation on shore?" retorted the Captain.

Cawthorne winced. Not one guess—not a particle of theory had any of the officers or engineers of the fleet expressed as to that mysterious and appalling agent and, knowing nothing of its origin, no idea of its limit could be evolved.

and at twelve-foot intervals were small hollow balls—evidently of aluminum.

They shouted back to the cruiser of their discovery and the launch took Cawthorne, Kilroth and a lieutenant to the barge with orders to secure that wire and take it to the flagship. It was very fine and of some composite metal which neither of the men could designate.

Kilroth, who had closely examined the two ends, exclaimed:

"One end has been broken—torn apart. See this!" and he held up the wire showing the end raveled out, more like a piece of fibrous cloth than like metal. The other end showed distinctly the clean, incisive mark of keen clippers.

But it showed nothing clearly to the engineers and naval officers who were brought over to the flagship from every battleship in the bay. They decided that the aluminum balls were floats to hold that wire—as they found by tests—thirty or forty feet below the surface.

BARON MÜNCHHAUSEN,

as will be noted, has failed to make his appearance this month. Urgent Wireless Telegrams to his chronologist-in-chief, the Hon. I. M. Alier, of Yankton, Mass., disclosed the fact that the venerable old gentleman has contracted a virulent case of *Atmospheris Marsianis*, which sometimes attacks Interplanetarian travelers not acclimatized to the peculiar Martian air. Mr. Alier, however, states that Professor Flitternix, the Baron's companion, advises him that Münchhausen will be back on the job next month. Of course we're sorry, but what can one do?

That night word was sent to the Admiral from a San Diego hospital that a man had been picked up on the south shore totally unconscious; that under medical

accounts of the mysterious current the physicians could not say.

* * * * * * * *

It was three days after that word was received that the man was awake and rational, and frantically eager to make something known to some officer of the navy. Cawthorne was invited to accompany the Admiral and two officers, and although the poor wretch on the cot was emaciated and showed evidences of a fearful struggle, both of mind and body, he slowly told his story. Eliminating his frequent pitiful demonstrations of terror or remorse and his occasional lapses into semi-unconsciousness, he revealed the following:

"My name is Forsythe—Lester Forsythe. Two years ago I invented a device something after the manner of a submarine torpedo, only it wasn't designed for explosives—only to transmit an electric current. I offered it to the United States men at a moderate price after they had made a full examination and tests, but they couldn't make any such contract with me. All they could do was to look into the thing thoroughly and then, if they liked it, recommend Congress to purchase. That was too indefinite to suit me and as the Japs got after me and made big offers I took it up with them. That was before there was the least indication of war.

"I went over to Japan and looked after the development and construction of a lot of those contrivances—we got to calling them 'Shirikari Tentacles.' Say those Japs can teach something about secrecy, all right. There wasn't a workman in those shops who ever got outside, or sent a letter

(*Continued on page* 593.)

The Marvels of Modern Physics

By Rogers D. Rusk

Assistant Instructor in Physics, Ohio Wesleyan University.

THE scientist who would communicate across space with our sister planets, or who would harness the sun directly, or who would do any other of the seeming impossibilities, has always been disbelieved, if not openly ridiculed. However, the change in attitude which has come over the world in a few short centuries is very striking.

Barely 300 years ago Galileo was twice brought before the court for daring to assert his theory of the rotation of the earth and was made to publicly retract his statement. He was heard to murmur afterward, though, "It does move, for all of that."

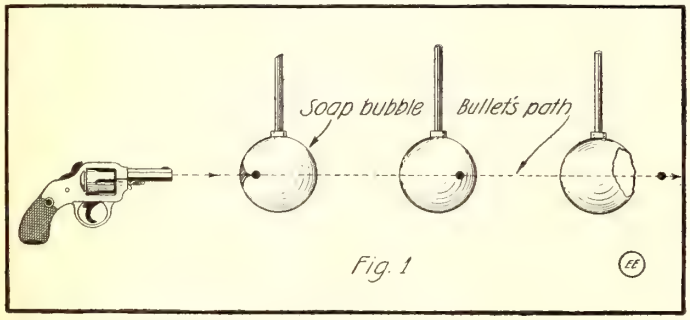


Fig. 1. Diagram Illustrating How a Soap Bubble Fails to Break Until a Bullet Fired Through Same Leaves the Bubble.

A hundred years ago, in our own land, a curious, skeptical crowd of people gathered on the banks of the Hudson River to see what would happen to the "crazy" man who thought he had invented a boat to run by steam. Robert Fulton's steamboat ran, however, "for all of that."

Thus it has always been. Science, besides her own battles, has had to combat the skepticism of the times, and only now is she coming into her rightful honors.

It is hard to measure just how great the accomplishments of the past few years are, for it takes ages to bring out the true worth of a discovery. We can gain an idea of the wonderful advance of the past century, however, by imagining one of the scientists of a hundred years ago brought back for a time to the busy world of to-day. Why, the very commonplace things of our life would amaze him. We can almost see him rubbing his eyes, his brain in a whirl, and at last in despair giving up trying to understand. The remarkable progress of the world would be very vivid to his eyes, while to our own it is hardly noticeable.

For this reason it is the purpose of this article (1) to emphasize some of the greater physical achievements of recent years and (2) to describe in some detail a few of the marvels of experimental physics which to the unscientific mind seem truly like absolute impossibilities.

The majority of recent inventions fall well within the domain of applied physics. Man's victory over the air with heavier-than-air machines and the invention of wireless telegraphy are too well known to need emphasis.

Modern artillery, the seagoing submarine, the phonograph and the automobile, different as they are, are only advanced applications of important basic physical principles.

The field of modern physics has so broadened that it now touches in some way practically every material phase of human endeavor. This rapidly widening field and the constant stream of new discoveries and inventions serve to increase man's control over nature and decrease his physical limitations.

The X-ray has marvelously decreased the limitations of our vision, for we can now "look through" space and objects and even into the human body.

The spectroscope has enabled us to look even to the stars themselves and tell their composition.

Electricity has enabled us to turn night into day and has permitted us to send energy over a thin metallic wire that would create thousands of horsepower.

Modern photography has enabled us to picture the bullet in its flight (see Fig. 1), and even sound waves in the air, while the wireless telephone, like the magic carpet of Bagdad of old, has practically annihilated space. The fairy tales of the ancients are indeed coming true, it seems.

All of the above facts are public property. Nearly every person has heard of them and knows something about them. Few people, however, ever stop to think that these were not the products of a moment's labor or chance discovery. In reality it has taken many years of painstaking labor on the principles involved to make them possible.

The results achieved in the field of pure physical research by those who are pushing forward the boundaries of science are often more marvelous than those results better known to the world.

In later articles the writer may take up the problems which modern physicists are attacking and the results so far achieved, but on account of space limitations this is impossible at present.

Physical research of late years has been most successful in the realms of electricity and radiation. Because these results, in a marvelous manner, have gone a long way toward answering some of the great questions of science, examples of the results obtained will be confined to these fields alone.

Fifty years ago scientists knew that matter could be divided into particles called *molecules,* but to this day the molecule itself has not been seen, for it would take, on an average, about 1,000 molecules, side by side, to make a speck visible with the strongest microscope. However, we know perfectly well that the molecule really exists. Our best proofs come from experimentation with gases and it has lately been proved that the so-called *Brownian movements* are caused by them. Brownian movements have been known for some time as the movements of a globule of liquid (generally oil) suspended in air, or some gases in which there are absolutely no currents. Notwithstanding the fact that the gas may be perfectly stagnant, the globules will dance around at a merry rate due to their bombardment by the flying molecules.

So much for the molecule, but that does not help us very much with reference to the *atom.* Still more impossible to see, how are we to know that it exists? It is a well-known fact that the molecule of any chemical compound can be separated into its constituent parts, and these smallest divisible parts of the elements themselves we term atoms. Practically the same proofs of their physical existence apply to molecules, but the theory that these are the smallest possible divisions of matter is everlastingly exploded by the electron theory. This theory asserts that the atom is composed of a positively charged nuclear mass, about which revolves, at relatively large distances, elemental particles or negative electric charges—the *electrons.*

Truly, here we have an advance into the universe of the minute as remarkable and as wonderful as any journey might be among the bodies of our heavenly universe.

As we have never seen the molecule or atom, it might seem a greater impossibility to prove the existence of the electron.

One of the most brilliant experiments of all science, however, was performed by Prof. Milliken, of Chicago University, when he actually caught and measured the electron. His method was simple enough to admit of explanation here, and all the more valuable on account of its simplicity, as the amount of error in the experiment was thus diminished.

An ordinary atomizer (A) was connected with a reservoir (R), as in Fig. 2, and globules of oil were forced into R from the atomizer by a stream of air passing through glass wool in the tube T, which caught the dust present in the air.

A single droplet of oil was then allowed to drop through a pinhole (P) between two metal plates M and N. As the drop fell it was observed through a magnifying telescope, and an electric field was created between M and N by connecting these plates to a source of current. The speed of the falling droplet of oil could now be increased or diminished, depending on the direction of the field, because the droplet itself carried a slight charge resulting from friction. By adjusting the field the droplet could be made to move at will between the plates M and N. In time the droplet would meet and catch upon its surface an *ion* from the air—an ion, of course, being the carrier of an electric charge.

The sign and size of the ionic charge could be measured by its effect on the speed of the droplet, and if the sign was found negative it was then due to the *electron,* which is always considered negative. Thus did Prof. Milliken capture and measure the electron, but many careful adjustments and methods of precision were necessary, in addition, to bring about the best results. That the size of the electron was determined as one twelve-hundredth that of a hydrogen atom is proof in itself of the brilliancy of the experiment.

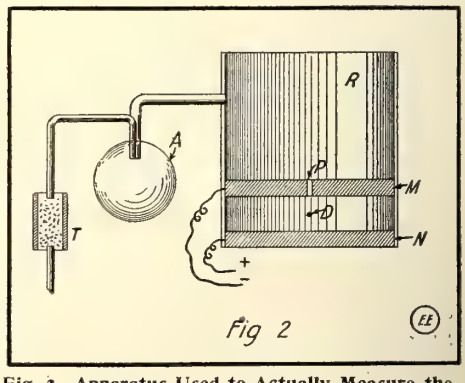


Fig. 2. Apparatus Used to Actually Measure the Electron, by Prof. Milliken.

Rutherford's work on the positive particle is equally famous. In his well-known "Counting Experiment" he determined the charge of a positive particle by counting

(*Continued on page* 594.)



RADIO DEPARTMENT



Latest De Forest Radio Apparatus

DR. DE FOREST and his associates have been recently developing several new radio apparata which we herewith illustrate. Fig. 1 depicts his latest portable wireless telegraphic and telephonic transmitter, as well as receiving outfit. This machine is of the "arc" type and operates on 600 volts direct current. The arc is specially constructed, consisting of two platinum alloy electrodes, which are cooled by means of radiating vanes surrounding them. This self-starting arc is enclosed in the case. The oscillating circuit consists of a variable capacity shown on the left of the case, a variable inductance seen in the center foreground of the cabinet and a hot wire ammeter, shown in the center background, which latter is used for indicating the amount of current transmitted to the antenna. The current in the circuit is varied by the voice through the medium of two specially designed microphones interlocked in parallel with a single mouthpiece connected to both as perceived in the illustration. This set can also be used for telegraphic transmission by substituting the regular telegraph key for the microphone. This is done by merely changing the position of a 2-point switch, which is located on the left of the transmitter bracket base, the key being placed on the cover of the cabinet as depicted in the illustration.

The receiver consists of the standard "audion" detector, variable inductances and capacity and a pair of 'phones. The receiving cabinet is shown on the lower left part of the illustration. This outfit is very compact and portable, which makes it the ideal set for scouting work.

One of the latest audion and ultra-audion receiving sets which is capable of receiving both undamped and damped wave stations is shown in Fig. 4. This consists of an ultra-audion tube, as perceived, with its grid and wing connected properly to an inductance and variable capacity. This is done for the purpose of making the audion oscillate in order to produce "beats," which is essential, of course, for the reception of signals transmitted by stations employing the arc or high frequency alternator. The oscillations produced by the audion are regulated by means of a bridge condenser placed on the lower center part of the cabinet as perceived. An ammeter is used for indicating the amount of current the bulb filament is consuming. The high voltage current in the tube is supplied by a dynamo of from 80 to 125 volt capacity, being regulated by means of a potentiometer which is seen in the extreme upper corner of the illustration. With the potentiometer method of regulating the high voltage a finer adjustment than with batteries can be obtained, as small increments of voltages can be made by merely changing the position of the runner of the regulating instrument. This also eliminates the troublesome batteries, which were, until the present, always used on high-grade audion receiving outfits. A switch for changing from *arc* to *spark* receiving is provided and is seen at the lower right corner of the cabinet. This set is exclusively used by the United States navy on its battleships.

An audion cabinet set for the amateur is also one of the latest products of the De Forest laboratory. One of these is illustrated in Fig. 3. Its cabinet is modeled similarly to the commercial ones. One feature of this type of audion receptor is that it employs a potentiometer for regulating the high voltage battery in the wing circuit, thus eliminating the unnecessary switch contacts. The old method of regulating the high voltage was not very delicate, as increments of four volts could only be added to the circuit, but with this method infinitesimal increments of voltage can be admitted to the wing circuit. The potentiometer is shown on the upper left corner of the audion and consists of a high resistance semi-circular graphite rod, held in place by means of two substantial brass clips. The switch handle contains a circular graphite button sliding over the rod. The only thing that is necessary is to con-

(*Continued on page 592.*)

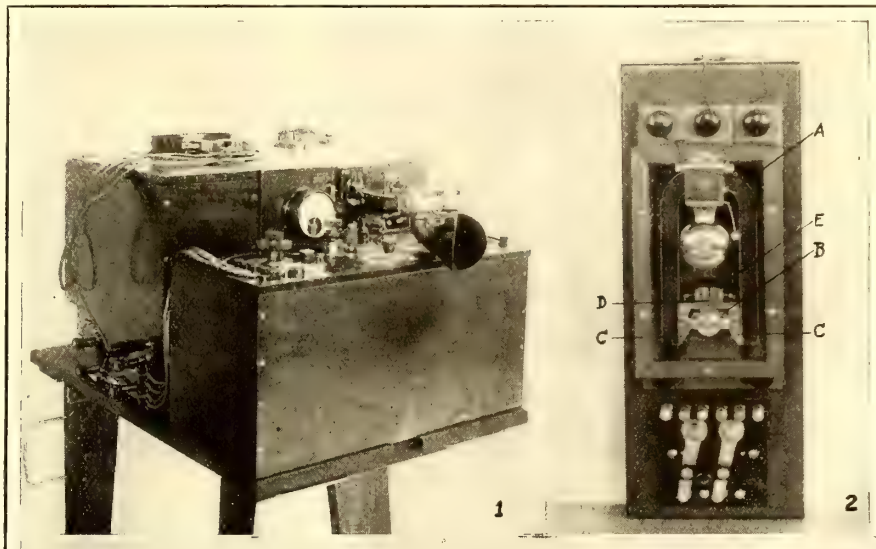
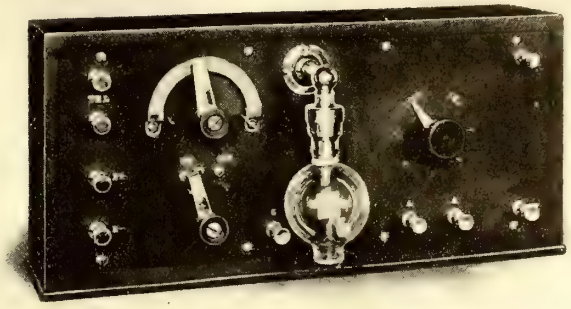


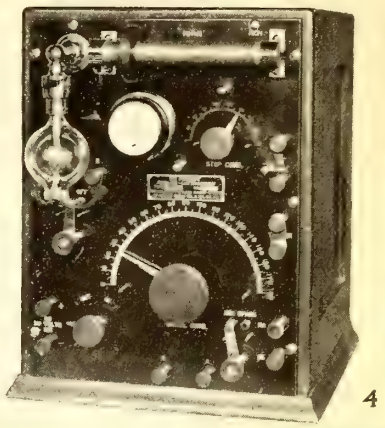
Fig. 1 Illustrates Appearance of new De Forest Wireless Telephone and Telegraph Set for Portable Work.

Fig. 2. Depicts Ultra-Sensitive Polarized Relay for Use with Audion or Other Radio Detectors, to Permit of Recording the Signals on Paper Tape.

Fig. 3. A Newly Developed Audion Receiving Cabinet Intended for Experimenters and Others. Allows Use of 110 Volt Commercial Current.

Fig. 4. U. S. Navy Type Audion Receptor for Undamped or Damped Waves. Uses 110 Volt D.C. Through Special Potentiometer.

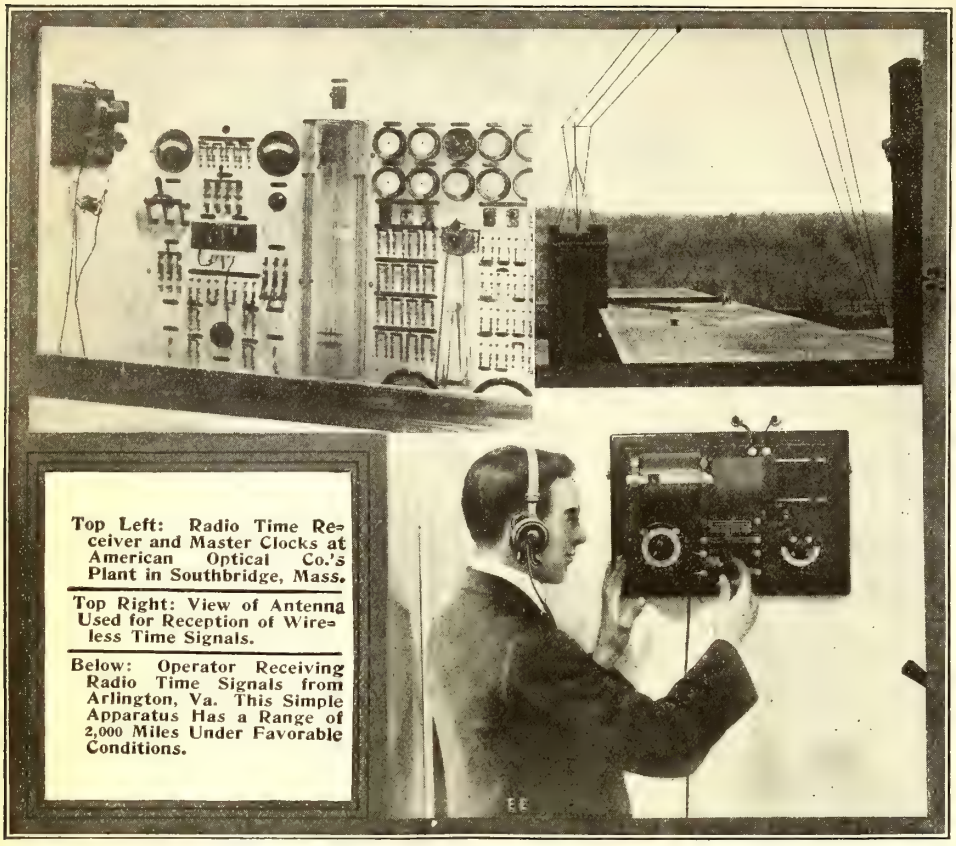




AMERICAN OPTICAL CO. INSTALLS RADIO TIME SET.

A one-way wireless station, capable only of receiving wireless messages, without any apparatus for sending, has now become popular among industrial concerns, who find the wireless a convenient and accurate means for receiving standard time daily at noon and 10:00 p. m. This economical apparatus, costing but a small amount, consists simply of a receiving panel about 20x16 inches and a suitable aerial. This receiving apparatus is capable under favorable conditions of receiving from a distance of 2,000 miles. Only a short time is required for the operator to learn the standard wireless time code, so as to be able to receive them properly.

The American Optical Company, of Southbridge, Mass., is among the latest to install a radio time receiving apparatus with which it gets standard time from Arlington, Va., daily. The yearly saving and convenience of the wireless message over the telegram has satisfied the officials of this concern that the venture is to be a most satisfactory one. Referring to the group of illustrations the time clocks to be checked by radio twice daily are seen in the upper left view. The antenna is observed at the right, as well as the operator in the act of tuning in the time signals.



Top Left: Radio Time Receiver and Master Clocks at American Optical Co.'s Plant in Southbridge, Mass.

Top Right: View of Antenna Used for Reception of Wireless Time Signals.

Below: Operator Receiving Radio Time Signals from Arlington, Va. This Simple Apparatus Has a Range of 2,000 Miles Under Favorable Conditions.

GREAT LAKES SHIPS OPEN WAR ON MARCONI RADIO.

Expressing the intention of putting in $20,000 worth of wireless equipment to free itself from the present wireless control of the Great Lakes service, the Goodrich Transit Co. announced it had closed with Kilbourne & Clark, of Seattle, for independent wireless equipment for the steamship "Nevada," now building at Manitowoc, Wis. The new ice crusher went into service in December.

W. H. Thorp, vice-president and general manager of the Goodrich Co., stated recently:

"The Marconi charges have increased approximately 100 per cent. within a recent period. Their charges have to us become practically prohibitive. The public, both traveling and shipping, has come to demand wireless safety equipment, hence a great increase in the volume of wireless business."

NEW WIRELESS STATION AT CAVITE, MANILA.

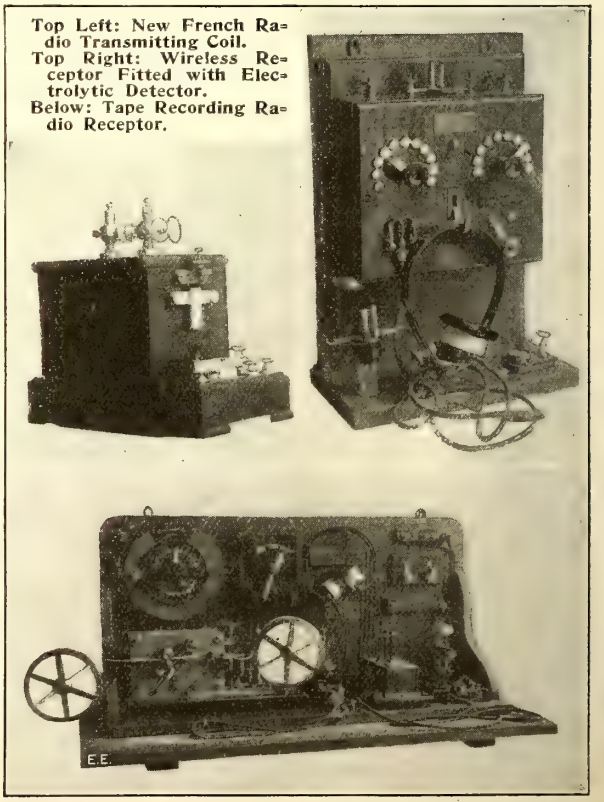
Three 600-foot steel towers for wireless stations are to be erected in Cavite in the near future. It is believed that towers of that height, if properly equipped, will be able to receive wireless messages across the Pacific Ocean.

NEW FRENCH RADIO INSTRUMENTS.

Several new French radio apparatus are illustrated herewith. Fig. 1 (upper left) shows an improved spark coil for use in portable wireless transmitting, which is operated on storage batteries. This coil is fitted with an extra heavy Morse key mounted on the base of the coil itself, as perceived. Also the vibrator is of special construction, so as to give a constant interrupter speed, and the contact spring carrying the platinum point is placed at right angles to the armature proper, as may be noted. By this method of construction the contact screw with platinum point is located in a vertical position and is thus more readily adjusted than in the common form of spark coil vibrator. This coil is fitted with a new form of spark gap, known as the "mushroom" gap, taking its name from the fact that the sparking electrodes have the form of a mushroom. The coil here shown is capable of transmitting 25 kilometers and measures 35 cm. long, 19 cm. wide and 28 cm. high. It operates on a four-volt storage battery successfully.

Fig. 2 (upper right) shows a very compact wireless receiving set of the Ducretet type, as supplied with a sealed point electrolytic detector, having a removable electrode, which is observed resting on the base at the left. This apparatus is fitted with an automatic cut-out switch for the battery circuit, on which the head 'phones may be hung when the instrument is not in use. This is a feature which many of the French and other foreign makers have incorporated in their sets, but the American manufacturers of similar machines seem loath, for some reason or other, to adopt. The tuning inductances of this receiving set are adjustable by means of two multi-point switches placed on the front of the cabinet, as illustration indicates. A mineral detector is also supplied with the set and may be seen at the right of the base in the illustration. Either detector may be placed into or out of the circuit, as there are provided slotted contact clips which are clamped under the binding post nuts on the top of the cabinet.

In Fig. 3 (bottom) is depicted a complete wireless receiving outfit capable of making a permanent record on a moving paper strip of the received radio signals. This complete apparatus includes a special rotary tuning coil observed at the upper left portion of the illustration. The equipment also includes head 'phones, which may be used in place of the tape recorder when desired. In conjunction with a sealed point electrolytic detector of very fine construction, there is operated an extremely sensitive polarized relay which in turn controls the tape recorder. When desired the signals may be interpreted by means of an electric bell, which is perceived at the right side of the set. Potentiometers and battery are, of course, incorporated in the make-up of the outfit for properly controlling the electrolytic detector .



Top Left: New French Radio Transmitting Coil.
Top Right: Wireless Receptor Fitted with Electrolytic Detector.
Below: Tape Recording Radio Receptor.

The Dubilier Multiple Musical Tone Radio System

RECENT progress in wireless communication has established this branch of science as an indispensable means of transmitting intelligence from one place to another without the use of connecting wires.

A great impetus was given to wireless when the signals transmitted were of a

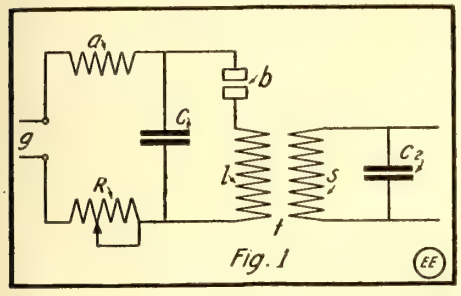


Fig. 1. Circuits of the Dubilier Radio Buzzer Set.

musical tone instead of a mere noise in a telephone receiver. For producing these tones usually an alternator or generator of the rotary type was used, but this becomes a difficult problem, especially for the outputs necessary for portable radio sets. With the elimination of these difficulties in view, but retaining the same desired characteristics, Mr. Dubilier has devised an apparatus by the application of what is known as the Multiple Musical Tone System.

The deserving characteristics of a higher note in the telephone receiver are well known, and is of great importance for the reason that it can easily be distinguished from frequent disturbing noises caused by atmospheric discharges, etc.; it has been proven that these tones carry far better and for longer distance with the minimum amount of energy.

In the present system used the sparks are produced by an alternating dynamo having a corresponding frequency, and as the pitch depends upon the number of cycles of the alternator, a variety of tones is obtained by changing the number of poles or by changing the speed. Both possibilities necessitate and require a complicated construction, combined with low efficiency.

By the system described later on most of the difficulties and defects are avoided; different tones can be produced, one immediately after the other, without any difficulty, and by reason of this a freedom

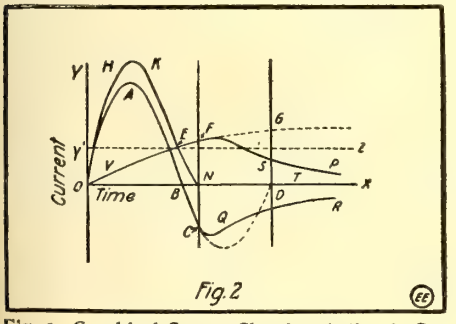


Fig. 2. Graphical Curves Showing Action in Dubilier Radio Transmitter.

from disturbance never attained heretofore is arrived at. Furthermore, for Governmental purposes, a message can be sent in different tones, hence cutting down to a minimum all possibility of interference from the enemy.

If the Morse or any other telegraph alphabet be used, the tone variations can also be employed by using different tones for the dots and dashes, thus preventing messages from being understood by outsiders. Owing to the fact that such a dash does not occupy more time than a dot in transmission, the sending speed of messages is also accelerated.

Due to the peculiar construction of the Dubilier apparatus, the efficiency of same, especially for small equipment, is higher than similar apparatus at present on the market. This is an important feature where a portable field, motor car or aeroplane installation is to be considered, for a maximum amount of power must be obtained with the lightest weight possible and in the smallest space.

In tests made it was found that as much as 50 per cent. of the direct current can be transformed into oscillations, and from this we can safely say it is 100 per cent. higher in efficiency than any other instrument.

In order to obtain the properties and characteristics of the multiple musical tone system, using direct current with an ideal impulse excitation, a connection as shown in Fig. 1 must be used.

In Fig. 1 g is a direct current source, a is an inductive resistance in the form of an electro-magnet for operating the oscillator b. The oscillator circuit c-l-b is tuned to the desired frequency. When resonance is caused to exist between the oscillating circuit and the oscillator there will be a steady and even current produced in the secondary s of the transformer f, which charges the high tension condenser c_2.

On all types of apparatus, using up to 500 watts and a magnetic mechanical oscillator, the electrical frequency of the oscillating circuit will control (to a certain extent) the vibrating frequency of the oscillator, that is to say, it will force the reed to vibrate at a desired frequency so as to keep in step with the circuit.

In Figure 2 the curve OY represents the current amplitude and OX the time axis. For the purpose of illustration, suppose the origin o to correspond with the moment when the condenser c, Fig. 1, is fully charged, and the oscillator b is closed. If the circuit were closed permanently the condenser would discharge through l, as a damped wave, indicated by the curve (Fig. 2) OABCD. Simultaneously the primary current from the source g arises gradually from zero, according to the ordinary exponential law, as shown by the curve OVEFG in Fig. 2.

In all of these types of apparatus, using an electro-magnetically controlled oscillator, a is the magnet coil operating on a spring which controls the (vibrator break) oscillator b. Let OY^1 (Fig. 2) represent the current through the magnets necessary to produce a force equal to the controlling force of the spring. This is also shown at E. The magnetic force of the coil a, however, must be a little more than the force of the spring in order to control it. This is shown at F on the curve. When the primary current through the magnet coil a reaches this point F, the oscillator is opened.

So that there will be no sparking or arcing at the oscillator gap b, there must be no current flowing when it opens. Adding therefore the two current curves OABCD and OVEFG we get OHKEN, the curve of the total current through the oscillator b and the primary l of the transformer. This curve, it is seen, falls at zero when the ordinate NC is equal to the ordinate NF. It is therefore evident that by varying the capacity c, and the resistance R (which determine the curves OVEFG and OABCD respectively), it becomes possible to so adjust the factors that OHKEN reaches zero at the instant of rupture of the circuit, and under these conditions there will be no sparking at the oscillator.

The primary current through the coil a does not cease instantly, but slowly dies away as the condenser c charges up, such as shown by curve FP. This is the charging current for the condenser. We complete the corresponding curve CQR.

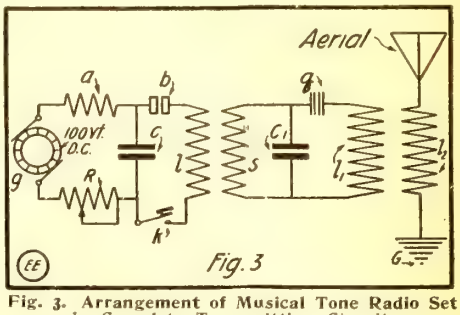


Fig. 3. Arrangement of Musical Tone Radio Set in Complete Transmitting Circuit.

This charging current flows through the coil a and serves to retain the oscillator spring; this keeping the oscillator open until some such point as S is reached, the ordinates OS being slightly less in value than OY_1. Here the oscillator closes again and the operation is repeated, commencing from the point O.

From the above it is obvious that the inductance a, resistance R, and capacity c, play important parts for the smooth operation of these instruments, and this is very well proven by experiment. Further, in order for the note to be a pure one, it is necessary that the second cycle must commence precisely at the point D (Fig. 2), and this can be attained by varying resistance R and the tension on the oscillator reed b.

Furthermore, it is at once seen that if the capacity c is increased, the curve FSP will decrease less rapidly and consequently the effective duration of the current through A, represented by distance ND, will be increased, and therefore the contact will remain open for a longer period, closing at some such point as T. But the

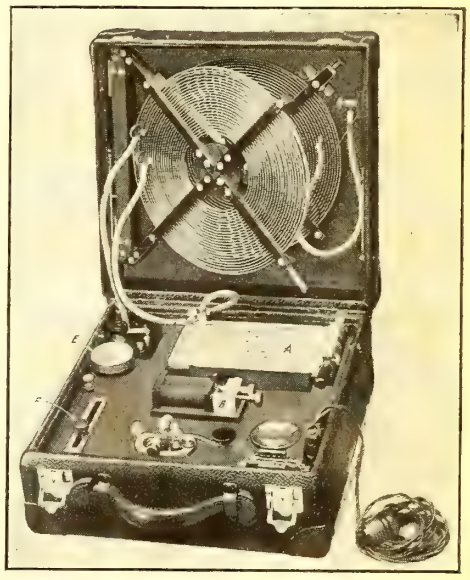


Fig. 4. Appearance of Commercial Dubilier Set.

curve OABCD will also have a greater time period, and will therefore approach zero at some point near T, so that the effective frequency of the oscillator is lowered. Resonance is then obtained by readjusting the primary resistance R, or spring

(*Continued on page 592.*)

The Electric Arc and Its Interesting Applications

By Morton W. Sterns

THE electric arc is such an ordinary sight that one no longer stops to consider it, or any of its numerous interesting applications, but if the subject is followed up there is a field for much experimentation and extremely interesting research.

The object of this article will be, therefore, to open up a new field for research, it is hoped, and one that can be followed up with but little outlay for apparatus.

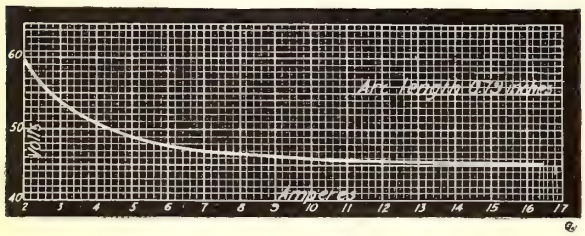


Fig. 1. Characteristic Curve of the "Arc" Showing Decrease of Potential with Increase of Current.

First of all let us consider the arc, what it is, and how produced.

Everyone knows that if two metal or carbon rods are connected to electric supply mains, brought together and then separated, current flows across the gap forming what is known as the electric *arc*. The current flows through the column of hot gaseous vapor, which is termed the *arc stream*, and flows from the positive or anode to the negative or cathode electrode.

The arc stream itself gives off a pale violet light, the useful part of the light coming from the luminous concave end of the anode in the case of the carbon arc.

If, however, the arc takes place between electrodes impregnated with various metallic oxides and salts the arc stream consists of the vaporized salts or oxides and becomes luminous at the high temperature of the arc; therefore in this case the arc stream gives off the greatest portion of the light, while the electrodes remain comparatively cool and do not give off an appreciable amount of light. This is known as the *luminous arc*.

By using various salts or oxides various colors can be obtained with the arc.

The electric arc between carbon or impregnated carbons can be maintained either by alternating or direct current, but it is very difficult to maintain an arc in which one or both electrodes are metal on alternating current, because the massive metal electrode cools so much faster than carbon that the metallic vapor is deposited and cools off each time the current goes through zero, thus preventing the formation of the arc during the next half cycle.

There is a property of the electric arc that is extremely important; that is, when the current through the arc *increases* the voltage across the arc necessary to maintain this current *decreases*.

This property is well shown in the curve of Fig. 1. This shows that it is necessary to always have a resistance connected in series with the arc to limit the current, otherwise due to the inherent characteristic of the arc, as shown by the curve, the current through the arc would increase indefinitely, constituting a short circuit.

This resistance is called the *ballast resistance*. On A. C. a choke coil may be used to limit the current.

One of the most familiar examples of the use of the electric arc is for illuminating purposes, and it is supplied in multitudinous shapes and forms. It is also an important factor in moving picture projection machines.

The arc is used in electric furnaces where very high temperatures are needed, as, for instance, in the manufacture of carborundum, a value of 7,500 degrees Fah. being obtainable.

Another application is in welding. Here the surface to be welded is used as one electrode, while a movable electrode held by the operator is brought into contact with it, forming an arc and thus causing the metal to melt and flow, thus closing up the cracks or fissures.

Another use of the electric arc is in the so-called "speaking arc." If the arc is connected up as shown in Fig. 2 and shunted by a telephone transmitter and a high resistance used to prevent the flow of excessive current from welding the carbon grains in the transmitter, thus rendering it inoperative, and words are spoken into the transmitter, the fluctuation of current in the transmitter circuit will cause a corresponding variation of current in the arc, thereby causing the arc to reproduce speech, music, etc. This property of the arc has been used to some extent as an advertising scheme by having a phonograph call out the wares for sale. Its greatest drawing power is due to the mystification of the passers-by as to where the voice emanates. They never suspect the innocent looking arc light suspended over the entrance.

Another interesting property of the electric arc is its ability to produce high frequency oscillations and the easy means of adjusting the frequency.

There are innumerable forms of such arcs in use and to describe all would be tedious and unnecessary, as they all operate on practically the same principle. We will, therefore, consider the Chaffée arc. This type of arc has the advantage of being easy to construct, is very efficient and requires but little attention.

A simple form of Chaffée or "whistling" arc is made by using a copper beaker filled with water to aid in cooling for one electrode, and a carbon or piece of aluminum for the other electrode. This latter electrode can be fastened to a block of wood and the length of the arc is varied by moving the block to or from the beaker, while both are resting on a flat surface.

If the arc is connected up as shown in Fig. 3 and shunted by a capacity and inductance high frequency oscillations will take place in the circuit containing inductance and capacity.

The reason for this is as follows: When the arc is started current flows, and since a certain voltage exists across the arc the condenser becomes charged. Now if the current fluctuates an infinitesimal amount the voltage across the arc rises or falls, as shown by the curve (Fig. 1,), and the condenser either gathers a higher charge or else discharges across the arc.

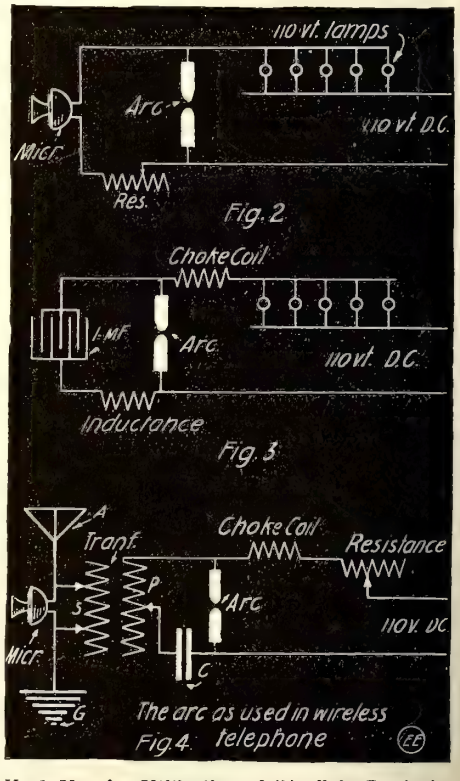
Consider the arc as existing with a certain current flowing and a certain voltage existing across its terminals, the condenser therefore has a certain charge stored in it.

If the current should decrease an infinitesimal amount, due to some cause or other, such as the fluttering of a brush on the dynamo commutator, we see that the voltage across the arc rises, and this causes an increase in the charge of the condenser, since $Q = CE$, where Q is the charge stored in the condenser, C is the capacity of the condenser and E the voltage across its terminals. The current would come back to normal the next instant and since the charge in the condenser is greater than that produced by the voltage now existing across its terminals, the voltage having fallen as shown by the curve, the condenser would discharge across the arc in the form of an oscillatory discharge of high frequency. Hence there would exist in the circuit containing an inductance and capacity high frequency oscillations, while in the arc circuit we would have a pulsating direct current. An inductance or choke coil is connected in the supply to prevent the high frequency currents from reaching the D. C. generator.

For ordinary experimental use the type of arc described above can be used and shunted by a 1 M. F. condenser of the ordinary telephone type and an inductance consisting of a coil of No. 20 B. & S. copper wire wound on a form 3 inches in diameter and 12 inches long, tapped about every 25 turns, or else it may be fitted with a slider, as on the ordinary tuning coil, which, in fact, can be used to good advantage.

Now by varying the inductance the frequency can be varied, and this will be shown by the tone of the whistle produced by the arc.

All tones of the scale can be produced, and the frequency can be increased to above audibility. At this point it can be used in wireless telephony.



Hook-Ups for Utilization of "Arc" in Producing Speech, Music, Etc.

To use the Chaffée or "whistling arc" for wireless telephony it would be well to build a more substantial arc, using a copper tube with water circulating in it for one electrode and an aluminum bar for the other electrode. It will help somewhat to have the arc take place in an atmosphere of ordinary illuminating gas or hydrogen gas.

(*Continued on page* 595.)

DETERMINING THE LAG BETWEEN ARLINGTON AND KEY WEST RADIO TIME SIGNALS.

Although not generally known, there is an appreciable and measurable lag in the time signals sent out by the powerful Government stations at Arlington, Va., and at Key West, Fla. Special chronographic apparatus, with suitable recording attachments, have been installed at the Elgin National Watch Co.'s plant at Elgin, Ill. Frank D. Urie reports on the tests made at this point on the radio time signal lag in the Bulletin of the Astronomical Society. The distance between Arlington and Elgin is 700 miles and between the latter point and Key West 1,250 miles.

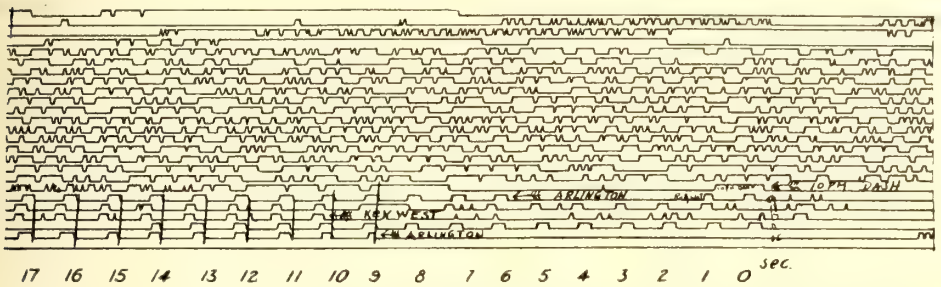


Chart Showing Record of Radio Time Signals and Lag Between Key West and Arlington.

A T-shaped aerial was employed at the Elgin plant, consisting of four wires, each 280 feet long and 150 feet high. To this antenna was connected a Telefunken receiving set, of the inductively coupled transformer pattern, using a galena detector.

The detector current was lead to a series of amplifiers, which intensified the Arlington signals sufficiently to operate a very sensitive relay, the back contact points of which controlled a five-ohm pony relay, and this in turn controlled the chronograph circuit. The individual apparatus was carefully checked up and special means for compensating the differences in the operation of the instruments were devised by Mr. Urie.

The transmitting clock at the United States Naval Observatory sends the time signals by wire to Arlington and also to Key West. At each of these radio stations the wire signals are automatically converted into radio signals. Owing to the 900 miles of telegraph wire between Washington and Key West, involving several make-circuit relays, the Key West radio time signals lag perceptibly on the Arlington radio time signals.

While developing the radio recording device Mr. Urie found that it was possible to record at Elgin both the Arlington and the Key West radio time signals on the same chronograph sheet. The determination of the time lag between Arlington and Key West was undertaken in January, 1915, at the request of Captain Hoogewerff, superintendent of the United States Naval Observatory. During February the investigation was interrupted by the destruction of the Elgin (Ill.) antenna in a sleet and wind storm. The antenna was replaced as soon as possible and the investigation was continued through March.

The plan was to record the first minute of Arlington, then tune to Key West and record the second, third and fourth minutes; then tune again to Arlington and record the fifth minute.

The accompanying reproduction of part of the chronograph sheet of Jan. 29, 1915, shows how this was done. After the record was obtained vertical lines were drawn between the same seconds of the first and fifth minutes of Arlington. The lag of Key West could then be directly measured for every individual second. This method has the advantage that it eliminates entirely any errors in the teeth of the contact wheel of the transmitting clock, as the lag is always measured from the records of the same individual second.

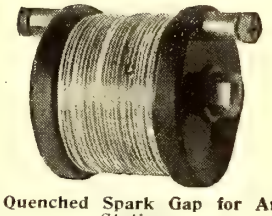
The results of the lag determination are:

	No. of comparisons.	Lag of Key West.
Jan. 23, 1915.....	29	0.277 sec.
" 26, 1915.....	16	0.250 "
" 29, 1915.....	77	0.267 "
Mar. 8, 1915.....	22	0.240 "
" 10, 1915.....	48	0.120 "

Apparently there was some unusual lag on March 10 in the Arlington signals. This date has, therefore, been rejected in taking the average result of the determination, which gives the lag between Arlington and Key West as + 0.258 sec.

NEW QUENCHED SPARK GAP FOR AMATEURS.

A unique quenched spark gap has recently been put on the market which undoubtedly will find favor among radio experimenters. As is well known, the quenched spark gap is one of the very best available for this class of work and it produces a pure wave, as required by the United States radio law now in effect, and besides has several other valuable inherent characteristics.



New Quenched Spark Gap for Amateur Stations.

The quenched gap in question is shown in the illustration herewith and measures 2¾ inches long by 1⅞ inches in diameter, having 24 gaps of standard length, viz.: .01 inch each, and thus the gap will handle about 24,000 volts, such as from a spark coil, etc. A less number of gaps than the total number may be readily used in the circuit by leaving one wire connected to the end terminal, and the second connection from the condenser circuit is secured around one of the brass plates making up the gap. For high power sets using transformers several of these gaps are connected in series-parallel, to accommodate properly the amount of energy passing through the circuit.

This gap, as may be observed, is composed of two fiber end discs carrying the binding post terminals and each of these is clamped to the end gap plates. Between every two metal plates there is inserted a mica washer of the proper thickness and these are so perforated as to provide a true vacuum gap between the spark plates. This, of course, is absolutely necessary if the quenching is to be performed in the proper manner and as necessitated in the action of this particular piece of apparatus. There are some gaps on the market that are termed quenched gaps by their sponsors, but in reality they are no such thing, as the sparking electrodes are placed in the open air. This gap is readily assembled and disassembled by means of a strong center bolt and nut which clamps the whole together firmly in one operation. It is also well ventilated inside and outside, as there are several holes drilled through the fiber end discs, thus providing double ventilation.

SAYVILLE WIRELESS WORKING AGAIN.

Wireless communication via Sayville, N. Y., is restored and messages can again be accepted to go by wireless via Sayville to Germany, Austria-Hungary, Turkey and non-belligerent countries.

A COMPACT RADIO DETECTOR CABINET.

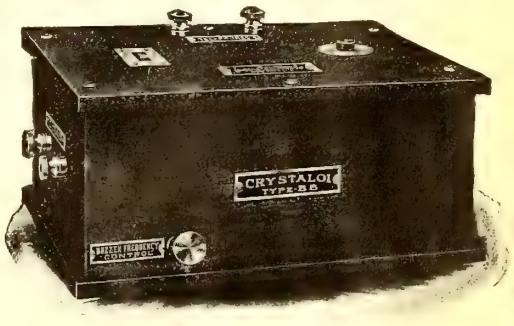
In the new detector cabinet here illustrated there is embodied in a single unit every element necessary to rectify into audibility any wireless signals you care to hear.

This set consists of a highly finished mahogany case in which is located a supersensitive Crystaloi detector cylinder, the periphery of which protrudes through the top, making it accessible for rotating to secure finest adjustment. A cohering inductance especially calculated and calibrated to the supersensitive detector is included, as well as a fixed condenser with the exact capacity for this particular instrument. A specially wound buzzer, the frequency of which is controlled by a knurled screw head mounted on the front of the case to produce a note that is best suited to assist in cohering the alloy in the cylinder is mounted within the neat cabinet, also two of the highest grade dry batteries to operate the buzzer. A buzzer control button protrudes through the top of the case for accessibility.

This case is equipped with four binding posts, two of which are for the 'phones and two for the tuner leads and is provided with anti-shock feet which renders it immune from mechanical shocks and jars.

The specially wound buzzer has an adjustable frequency range of 1,000 to 2,000 vibrations per second.

With this carefully designed and calibrated instrument you have but to set it on the table, connect your 'phones and leads from your tuning coil and you are permanently and thoroughly equipped to engage in the most serious wireless work of the present day. Of course, variable condensers can be added if desired. The fact that every part of this apparatus is designed, built and proportioned to work with each other makes it a superior piece of wireless mechanism.



Neat Radio Detector and Test Buzzer Set.

Manager, H. Gernsback

The RADIO LEAGUE of AMERICA

HONORARY MEMBERS
CAPT. W.H.G. BULLARD, U.S.N. NIKOLA TESLA.
PROF. REGINALD FESSENDEN. DR. LEE DE FOREST.

Subsidiary Radio Clubs.

SINCE the formation of the RADIO LEAGUE OF AMERICA two months ago we have been asked by a great many local Wireless Clubs as well as by local Wireless Associations if these organizations could become directly connected with the LEAGUE in some form or other.

As the LEAGUE champions the cause of all Radio Amateurs, without exception, it is highly desirable that every radio club should become directly affiliated with the LEAGUE. The RADIO LEAGUE OF AMERICA being a central body, organized to bring all the Amateurs together, to ward off hostile legislation and to serve the United States during peace as well as during war, it is in an excellent position not only to benefit every Amateur, but every local club as well.

It is highly probable that the future will see new attempts to curb the Amateur. Hostile bills will certainly be introduced in Congress, and it is one of the first duties of the RADIO LEAGUE OF AMERICA to safeguard the Amateur's rights. No other body is in such an excellent position to do this as the LEAGUE. No other body can obtain facts quicker or better than the LEAGUE. Therefore, if all the local clubs and associations are directly affiliated with the LEAGUE, only good can come of it.

Of course this is not the only reason. Suppose that every club and all its members were directly affiliated with the LEAGUE. Also suppose that, for obvious reasons, the Government should wish to mobilize all the Amateurs, be it for a test maneuvre or for actual eventualities. Would not the LEAGUE be in a paramount position to quickly convey such intelligence to the affiliated clubs and its members? Naturally this can only be effected in a satisfactory manner if the names of the clubs are on file and if its members are enrolled in the LEAGUE.

In order that a club or association can become affiliated directly and permanently, the following is required:

The president as well as two officers of the club must be members of the RADIO LEAGUE OF AMERICA. Upon application to the manager of the LEAGUE, a special certificate will be made out to the club and this certificate must be constantly displayed at the club's headquarters.

A special form of application blank as well as detailed instructions will be furnished by the manager of the LEAGUE upon request to the secretaries of local clubs and associations.

It is, of course, understood that there are no fees, or membership dues to be paid to the LEAGUE either by the club, by its officers or by its members. The manager hopes to hear from every club and every association in due time.

Formation of New Clubs.

We stated in our December issue how exceedingly simple it is for Amateurs to form new clubs. As the RADIO LEAGUE OF AMERICA now has above 5,000 members scattered all over the United States, it becomes an easy matter to bring Amateurs together.

As an example, suppose you live in Springfield, Ohio. (This city was taken at random.) As all records of members' names of the LEAGUE are filed geographically, the writer is informed that there are 19 members enrolled from Springfield, Ohio. Offhand we do not know if there exists a Radio Club in Springfield, but let us assume there is none as yet. Also let us assume that you are a live and wide-awake member living in Springfield. By sending a stamped return envelope to the manager of the LEAGUE and stating your desire, the LEAGUE will furnish you, free of charge, with the names of 19 members. You can thus easily get into touch with them, and a new club may be formed in this manner with but little trouble.

In our March number will be found one of the most elaborate articles ever printed on how to form and manage a Radio Club. It will be exceedingly well illustrated with pictures of existing clubs, their radio equipment, etc., etc.

In that issue will also be found a complete Directory of Radio Clubs in the United States. Do not miss this issue.

To Members of the R. L. O. A.

Those members not having received their membership blanks till recently will kindly excuse the delay. The first 1,200 blanks were promptly mailed in the middle of December. This amount represented the entire supply delivered, as our lithographer had an unfortunate accident in breaking the stone from which the certificates are printed. This naturally caused an unavoidable delay, and for that reason the balance of the certificates could not be mailed before the middle of January. We now have a large supply at hand, and if by chance anyone should not have received his certificate the manager will be glad to look into the complaint at once.

To Radio Clubs.

As announced above, the March issue will contain a complete Directory of all Radio Clubs in the United States. We will publish the names of all clubs about which announcements have been published in *The Electrical Experimenter*, as well as in other journals in the past. In order to make the directory complete, those clubs not having been announced in the wireless and kindred journals will kindly communicate with the manager of the RADIO LEAGUE at once. The benefit that the clubs and associations will derive by being listed in the Directory is obvious. *The Electrical Experimenter* now prints over 53,000 copies monthly and is read by over 150,000 wireless enthusiasts. It is by far the most widely distributed Wireless Organ, barring none, in the world.

* * *

Complete information of the RADIO LEAGUE OF AMERICA, its purpose and its plans will be mailed free for the asking. Every American Wireless Amateur is eligible as a member. Beautiful membership certificate free to members. The LEAGUE is not a money-making organization. There are no fees, no membership dues, etc. WRITE *TO-DAY*.

BROOKLYN, N. Y., YOUTH MAKES VALUABLE RADIO INVENTION.

Government experts recently concluded their tests as to the practicability of the under water telegraph device for submarines, invented by Elmer Matthew Rave, of Brooklyn, N. Y., and reported to Secretary of the Navy Daniels that the device passed every test. The inventor, 20 years old, offered the invention to the Government for a sum total of $275,000.

Young Rave has received many offers from foreign governments for the mechanism which is designed for the protection of sailors in submarines. The most flattering was made, it is understood, through D. Fedotoff, naval attache of the Russian Imperial Embassy, but Rave decided to offer it to the United States before considering any offer from foreign nations.

The tests covered a period of some weeks and were very exhaustive. The Government officials were given strict instructions to go to the bottom of the matter and find out if the invention was at all feasible and practicable. Their report is exceedingly gratifying to Mr. Rave.

This invention, which will be controlled by wireless, will take the place of the present submarine sound signaling bell system, now in universal use in submarines. It will enable a crew of a submarine, while submerged, to communicate by wireless with other ships or stations. In the case of an accident under water it will admit of a call for help.

Rave is a graduate of Commercial High School, Brooklyn, and has been working on the invention since the disaster to the submarine F-4 in Honolulu Harbor.

9,000-MILE RADIO A NEW RECORD.

What is stated to be a record in radio transmission was established on Nov. 29 last, when an operator for the Federal Wireless Telegraph Co. at Honolulu picked up wireless messages being transmitted from Nauen, Prussia, to Tuckerton, N. J., approximately 9,000 miles away.

The German operator was sending war despatches, and the dots and dashes registered so clearly in the Honolulu radio station that the eavesdropper had no difficulty in copying the report.

TO ISSUE NATIONAL EDITION OF LIST OF RADIO STATIONS.

The United States Bureau of Navigation, Department of Commerce, has in the hands of the Public Printer, its annual edition of the "List of radio stations of the United States," containing a list of 5,073 stations. The table here given shows the number of land, ship, special land, and amateur stations in this publication, as compared with that of 1914:

Classes of stations.	1914.	1915.	Increase.
Government and commercial land stations	189	224	35
Do. ship stations	895	895	0
Special land stations.....	54	118	64
General and restricted amateur stations 2,796	3,836		**1,040**
Total 3,934	5.073		1,139

The appendix to this list contains several articles of interest to radio operators. The book, which has been available since Nov. 1, may be procured from the Superintendent of Documents, Washington, D. C., at 15 cents per copy. Copies of the "Radio-communication laws and regulations" may be procured from the Superintendent of Documents at 15 cents per copy.

THE CONSTRUCTOR



Construction of a Collin's Radiophone Arc

By H. Winfield Secor

WIRELESS telephony is possibly the most interesting branch of science with which the radio and electrical experimenter comes in contact. Herewith directions are given for constructing a Collin's Oscillating Arc, adapted for generating high-frequency currents well suited to experimental radiophonic requirements. Such an arc generator as here described can be made up quite cheaply, and, moreover, is of such design as to permit of a wide range of interesting experiments, such as enclosing the arc proper in a gas-tight chamber in which hydrogen, alcohol or illuminating gas can be used; also, the arc has been found to operate very satisfactorily in an envelope of steam.*

The constructional details of a Collin's Oscillating Arc generator are given in the illustration herewith presented. This arc, it may be said at the start, utilizes graphite discs, which rotate at fairly high speed, and the arc proper is sustained between their rapidly moving peripheries. Graphite has been found, after extensive tests at the United States Bureau of Standards laboratories, to be absolutely the best material for such an arc, especially when it is to be used for considerable periods, and to produce oscillations steadily without frequent readjustment of the apparatus.

The dimensions of the apparatus here suggested may be deviated from to some extent, without any detrimental effect, so long as the principal features are incorporated in the make-up of the whole. Referring to the working drawings (Figs. 1 and 2), A is a slate or asbestos composition switchboard about ½ inch thick. B is a brass strip making contact with the brass or phosphor bronze bearings N, in which the spindles carrying the rotating graphite discs revolve. A fiber or hard rubber block R is indicated, which has a width of 1½ inches. This carries the bearing N, also disc K, pinions P, etc., and may be moved up and down when adjusted by the screw S_1 at the top of the arc generator. A fiber or hard rubber block is denoted at D also, being about 1½ inches wide. Wrought iron or brass supports E are made up from ¼x½-inch stock or slightly heavier, if available.

The magnetic blast for this arc comprises wrought iron magnet cores F fitted to a wrought iron yoke G. Insulation on the varius parts of the apparatus, such as around the pinions, etc., is indicated by I. This is to prevent electrical connection between the pinion and shaft L, etc. Long machine screws, carrying large-sized knurled heads, are observed at J, the ends of same being ground or filed to a point, with about a 60-degree taper. These points face each other and are so arranged as to project between the revolving graphite discs.

At K is seen the graphite arc discs, made up from ¼-inch or ⅜-inch stock, with a diameter of about 2 inches. Carbon may be used, but it will not give the results obtainable with graphite. These discs are rotated by the shaft at the rear of the apparatus, which is driven by belt from a small fan motor at the rate of 400 r. p. m. or more. The arc length is varied by means of the adjustment screw S_1 and the charteristics of the arc may be changed also by adjusting the magnetic blow-out poles J.

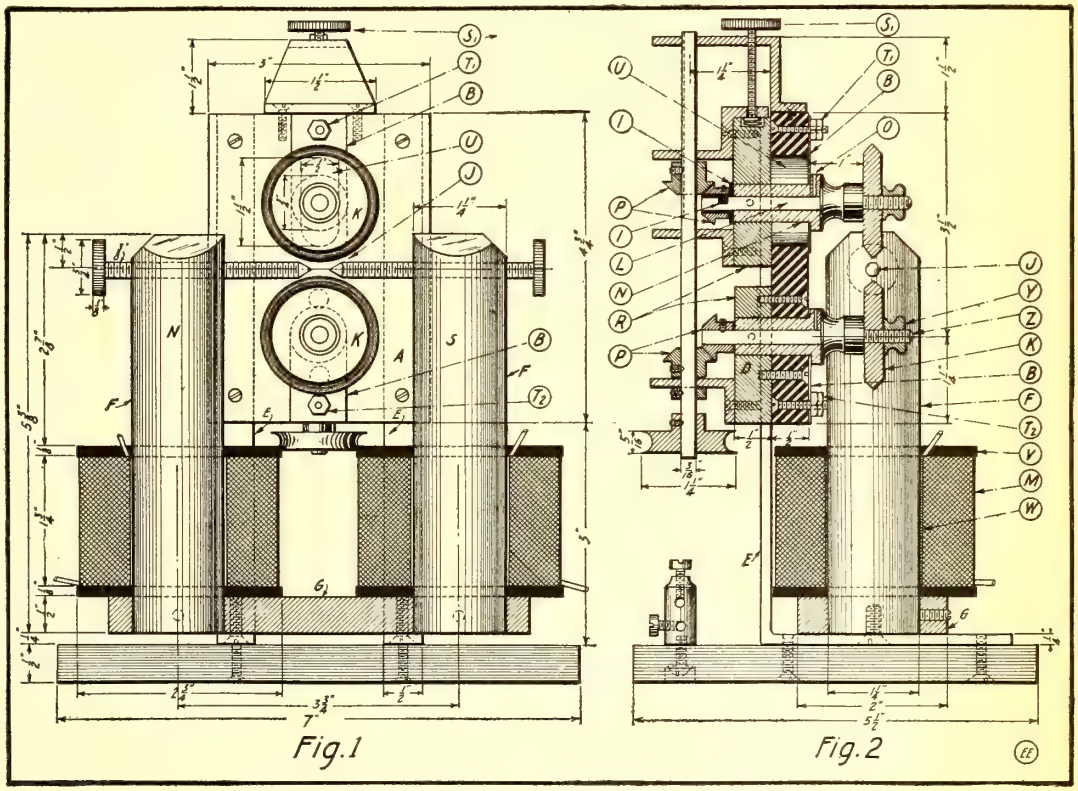
At the rear of the instrument there is a vertical iron or brass shaft L. This may be about 3/16 inch in diameter. It carries the small brass pinions P, the upper one of which is provided with a key, which slides in a key-way cut into the shaft as indicated in Fig. 2. This permits the upper electrode block R, together with the upper pinion P, to slide up and down the shaft while the latter is rotating. This arrangement will permit of adjusting the arc length while it is in operation, as becomes evident. All of the gear pinions P are of the same pitch (say about 32 pitch) and have 16 teeth per pinion.

The magnetic blow-out coils M each contain nine layers of No. 12 B. & S. double cotton-covered magnet wire. The two coils are connected in series to give north and south poles, respectively, at the adjustable electrode terminals J. The iron cores on which the magnet coils are wound are first insulated by winding three layers of Empire cloth around them.

The brass or phosphor bronze bearings N are provided with oil holes O. The upper bearing is movable up or down in a slot cut in the board A. The terminals of the arc proper are indicated at T_1 and T_2, either one being used for the positive electrode, according to the best result with respect to the polarity of the magnetic field applied.

It may be well to state that this arc should never be started—i. e., the current should not be applied to the rotating graphite electrodes—until they have been speeded up to a high velocity. Greatly enhanced results will be obtained with this or any arc generator if the arc proper is burned in an atmosphere of hydrogen or other vapor, and some vital points in this direction are cited later on in this article.

The diagram of connections for this arc generator intended for radio-telephony is observed at Fig. 3. Referring to this more in detail, CK are choke coils comprising soft iron wire cores 8 inches long by 1 inch in diameter. These are covered with three layers of Empire cloth, and over this three layers of No. 12 B. & S. insulated magnet



Working Drawings of Collin's Radiophone Arc Generator.

* See Reprint No. 60, Bureau of Standards Bulletin, "The Production of High Frequency Oscillations from the Electric Arc," by Dr. L. W. Austin.

wire is placed, taps being taken from each layer so as to allow for adjusting the choking effect. This arc may be used on 110 to 220 volts direct current, or even a higher voltage providing a sufficient resistance R is utilized to control the current properly.

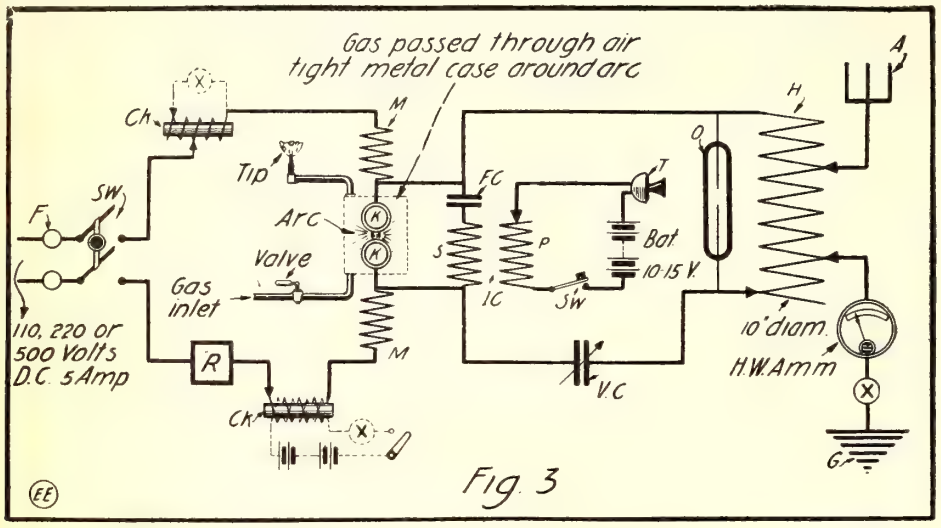


Fig. 3

Diagram of Connections for Wireless Telephone Arc.

VC is a rotary condenser of standard pattern, filled with *castor oil*, which has the effect of increasing the insulation of same and also of raising the capacity to about five times the original value, with air dielectric. The helix shown may comprise 30 turns of No. 6 brass or copper wire wound on a wooden frame 16 inches long and 10 inches in diameter, spacing the turns one-half inch apart. Suitable clips are used to permit the use of as much of the helix inductance as required. An instrument for indicating the maximum oscillations produced in the shunt arc circuit and known as the "oscilloscope," is shown at O. This may be purchased from any electro-therapeutical concern at small cost, but this is not necessary for general work.

The optional locations of the microphone transmitter T are indicated at points X X, etc. A common location for the microphone or transmitter is in series with the ground lead, as is also that for the hot wire ammeter. A method employed more or less for superimposing the voice currents on the arc circuit, utilizes an induction coil I C, which may be a ¼-inch spark coil. If this is not available a suitable induction coil may be made up with the following dimensions: soft iron wire core 5½ inches long and ½ inch in diameter, insulated with two layers of paper. A primary winding is wound over this, consisting of two layers of No. 20 B. & S.—D. C. C. magnet wire. Wound over the primary are six layers of Empire cloth and then the secondary coil, consisting of four ounces of No. 36 B. & S. enameled magnet wire is wound in place. This may be put on with paper between each layer. A fixed condenser, F C in the microphone superimposing circuit, may be made of three or four pieces of Empire cloth, each 8x10 inches — 1/100 inch in thickness, or 10 mils. These sheets are coated on both sides with slightly smaller tin-foil and the whole is then laid together with connections made to alternate tin-foil leaves, in the usual manner.

If illuminating gas is used in the gas-tight chamber placed around the arc, a good scheme is to provide a gas tip leading out of the chamber. The tip is lighted, as here indicated, for this is conducive to the best circulation of the gas through the chamber.

This set may be used on any size antenna, but, of course, the longer and higher the aerial wires, the more pronounced the results will be as regards the talking range. Any wireless receiving set will pick up radiophonic speech and this arc generator is capable of talking 20 to 25 miles when properly operated with a gas enveloped arc.

In case it is desired to superimpose the voice current on one of the choke coils C K, a secondary winding may be wound over the outside of the choke coil winding proper, as indicated; X being microphone and a battery, of course, being connected in series with the coil and the transmitter. This secondary coil may consist of three layers of No. 18 B. & S. insulated magnet wire and several layers of Empire cloth, or waxed paper should be interposed between the two windings.

Dr. L. W. Austin has ascertained that for a simple arc generator, graphite electrodes are better than most any other material, especially where steady oscillations are required for making quantitative observations and tests. The various circuit quantities employed in one of Dr. Austin's researches were as follows: Primary circuit of arc: Electrodes—graphite, flat ends, diameter 12 mm.; resistance in series with arc about 50 ohms; arc current 4 amperes; potential difference across arc 26 volts and across open circuit 242 volts; arc length about 0.3 mm.; inductance in shunt circuit .009 milli-henry; capacity 0.4 m.f.; alternating current in shunt 4.0 amperes. Secondary (inductively coupled) test circuit values: Inductance 0.168 milli-henry; capacity —variable; resistance circuit 7 ohms; current 0.1 to 0.2 amperes. With these conditions it was found that the arc would easily produce oscillations steadily for periods of one-half hour or longer. When the frequency was measured by the secondary resonance circuit, it was found that there were present well-marked maxima corresponding to frequencies of 205,000, 580,000 and 910,000 cycles per second. The lowest frequency appeared to carry the largest part of the energy, while the highest was the weakest. The frequency calculated from the inductance and capacity of the primary circuit; *i.e.*, shunt oscillatory circuit of the arc was 260,000 cycles per second. He was unable to find any other frequencies present, but the possibility of such seemed fairly certain.

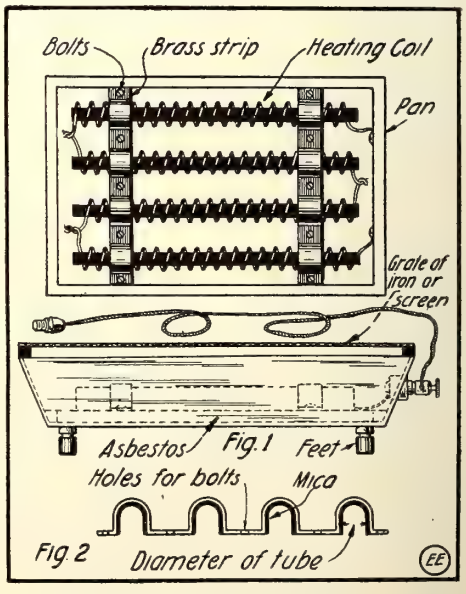
Burning the arc in hydrogen after Poulsen's method, Dr. Austin found, caused the more rapid production of oscillations, also permitting of a longer arc length or up to 0.8 mm. in the case of graphite at 240 volts line potential. Marked indeed was the increase of the amount of energy which could be drawn from the oscillating circuit. With the graphite arc in air only about 6 to 8 watts were available, but by utilizing a hydrogen envelope, over 100 watts could be drawn; in one experiment bringing a 110-volt—32 c.p. lamp to full brightness.

It seems that the effect of the hydrogen gas on the arc is partly due to the high heat conductivity of the gas, which thus helps to cool the electrodes. Poulsen claims, in addition to the cooling effect, that there is a marked influence on the electrical conductivity of the arc, which he considers of great importance. With the arc in steam all the benefits derived from hydrogen were readily duplicated. Oscillations of great power were also observed when the arc was formed under water, where the steam was produced by the heat of the discharge. Satisfactory results have been obtained with the arc burned in compressed air also. The arc, although ordinarily unstable, has thus been found to be a most satisfactory source of undamped waves for wireless purposes. Moreover, it is a device available to most all radio experimenters, and they will indeed find their time well spent in trying it out.

HOW TO MAKE AN ELECTRIC TOASTER.

The most palatable toast is said to be that made upon an electric toaster. The toaster herewith described can be constructed by anyone.

Procure a common bread pan or other metallic dish. Next obtain a piece of asbestos board ½ inch thick and just a trifle smaller than the inside of the pan. Place the asbestos inside of the pan and drill 10 holes in the bottom for tube clamps, as shown. Now obtain four porcelain tubes and upon each one wind about 30 turns of No. 24 German silver wire. Two strips of brass made, as shown in Fig. 2, are used to clamp the four resistance coils to the pan by means of ⅛-inch stove bolts and nuts. The coils are connected in series and the two end terminals are brought to two insulated binding posts as shown. Care should be taken to see that the binding posts do not touch any part of the pan, using mica or fibre washers around their securing screws. A small grate or screen of iron is made for the top of the toaster.



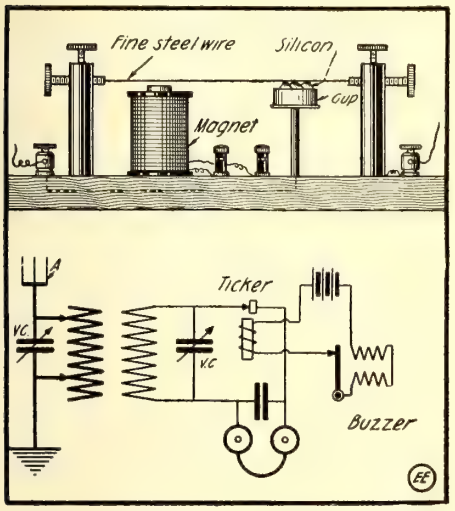
Details of Electric Toaster.

The wire should get red hot in a minute or so and by using less turns of the resistance wire in circuit the heating effect will be increased. Four porcelain knobs should be placed at the corners to raise the pan above the table. The drawing is self-explanatory. This toaster is intended for use on 110 volt circuits.

A SILICON "TIKKER."

Many radio amateurs, especially those living in the Eastern States, cannot catch Arc signals. The tikker, of which I give a drawing, is just the thing. A buzzer must be put in the circuit of the magnet to make the necessary interruptions. Build one, boys, and see what you have been missing!

Contributed by
LEIGHTON JOHNSTON.

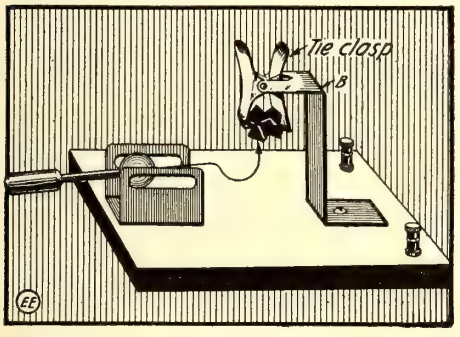


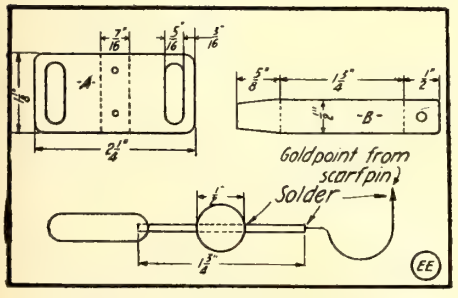
Tikker Comprising Steel Wire Vibrating Against Silicon.

A NOVEL DETECTOR.

Following is a description of a detector I made with which you can touch every part of the crystal by simply moving one knob.

First get some $\frac{1}{16}$-inch springy brass and cut to the shape shown at A. The openings can be made by first drilling holes and then filing. Then bend on dotted lines. Now get a brass ball ½-inch in diameter and drill a hole through it to admit the brass rod which has a thread on one end to take the knob. The ball and a piece of fine brass wire are soldered





Ball Adjustment for Mineral Detectors.

on the rod. I find the point from a gold scarf pin to be very sensitive as a "cat-whisker" and it does not tarnish. The standard, B, is made from heavy brass and the tie clasp is soldered on to hold the crystal. The inverted position of the crystal keeps the dust from settling on it and thus causing it to lose its sensitiveness. The base can be made from hard rubber or hard wood. Parts A should be tight enough to keep the ball in place. The knob can be moved back and forth or in any direction.

Contributed by G. F. EXNER.

MONEY-SAVING HINTS FOR THE EXPERIMENTER.

Electrical apparatus of all kinds involves an outlay of money which soon runs into quite appreciable amounts—at least to the junior mechanics. A few suggestions along the line of procuring some necessary materials may be of help in cutting down expenses to a minimum.

Fine resistance wire, for instance, is costly when bought at the supply houses, but a very cheap substitute that will do the work well, providing the working temperature is not too high, is the wire used in making galvanized window screens. This can be unraveled easily from a piece of screen, and the wire is continuous. I have made several small rheostats from this material and they all work well.

The brass lining of an old Ford automobile wind shield makes good slider rods for tuning coils, potentiometers, etc.

It is a good plan to save all old battery bolts, binding posts, connectors, brass ribbon, wire, etc., as they will prove useful at one time or another.

The rubber casings of discarded storage batteries may be employed to advantage in several ways. The sides may be cut out with a hack-saw and scraped and polished. These make good detector bases. If the case is unbroken it makes a good container for a small condenser which is to be immersed in oil.

Cheap sending condensers for spark coils up to one inch capacity can be made from small test tubes. The six-inch size is preferable. They should be coated inside and out to within one-half inch from the end with tinfoil. A tinfoil lead may be used as a connector to the inner coating by bringing it out through a hole in a paraffined cork plugged in the opening.

Supports for the terminals of a small spark gap can be made from the lightning arresters on old-fashioned telephones. These consist of three large binding posts, with a half-inch hole drilled transversely through each for holding the carbon rods. Zinc may be used in place of the carbon rods, and a series gap is the result.

An efficient ground connection can be made from a 1½-inch galvanized iron pipe which has been burst by freezing. A cap should be placed on one end and the pipe driven into moist ground to a depth of at least six feet. Strong salt water should be poured into the open end of the pipe until the earth near the pipe is thoroughly moist. The ground wire may then be soldered to the top of the pipe or secured by means of a clamp. Water must be poured down the pipe frequently for best results.

Contributed by FRANK SAHLMAN.

1,000 FEET COLLAPSIBLE RADIO MAST.

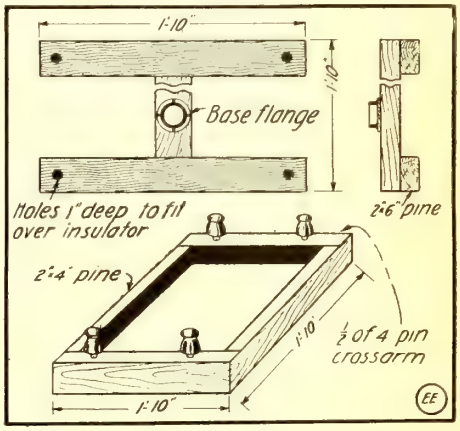
Push a button and, presto—you've got a wireless tower 1,000 feet high. Such a tower is under consideration by the United States War and Navy departments for adoption as part of the new national defense scheme. The inventor is Joseph Raes, an American citizen, native of Belgium, now living in Washington.

The tower is made of steel tubing, like a giant collapsible fishpole. It can be mounted on a concrete base; smaller towers can be attached to motor trucks.

Each tower has guy wires attached to powerful springs, which coil up the guys when the tower is "down." When the tower goes "up" the guy wires and harp strings for the wireless are spread automatically. It is strong enough to bear searchlights, machine guns and signaling apparatus.

INSULATED AERIAL MAST BASE.

To insulate the base of my iron pipe mast I took a four-pin cross-arm and sawed it



Insulated Antenna Mast Base.

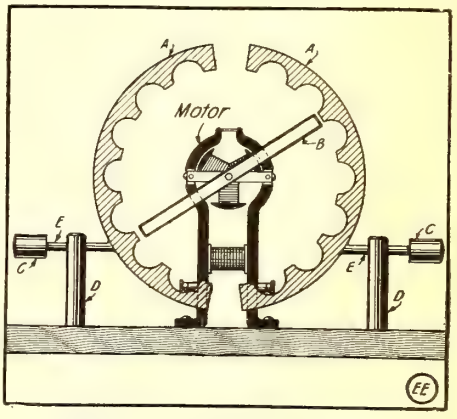
in two. Over this was placed a base made of yellow pine bored to fit down over the isulators about 1 inch. I use high tension porcelain insulators on the pins. By referring to diagram the base can be very easily made.

Contributed by P. F. RUTHERFORD.

UNIQUE ROTARY SPARK GAP.

The parts necessary to construct this rotary gap are as follows: A small motor, a sheet of brass 6 inches square and ⅛ inch thick, two large binding posts, a piece of brass 5x1x⅛ inch, a piece of brass rod 6 or 8 inches long and ⅛ inch in diameter. A—Stationary electrodes, which are cut out of the square sheet of brass. B—Rotating bar, which is fastened on the motor shaft. C—Hard rubber knobs. D—Large binding posts. E—Brass rod.

To operate this gap the rod which is fastened on A is put through the hole in



Effective Type of Small Rotary Gap.

the binding post and then adjusted as near the rotating bar as seems best, and to be found by test. The motor can be a common battery motor.

Contributed by JOHN WEBER, JR.

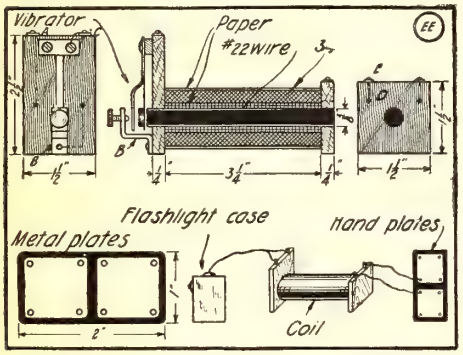
WRECKED.

The explosion of an alcohol tank wrecked the Naval wireless station at Cordova, Alaska, recently and caused the injury of three enlisted men, according to a report received at the Navy Department.

AN ELECTRICAL HAND-SHAKING SURPRISE.

I have decided to contribute an idea of mine with which I have had all kinds of fun. It is a hand-shaking, shocking device which works to perfection. Observe the drawing, which I have made very simple.

The most important thing is the induc-



Apparatus for Electrical Hand-shaking Surprise.

tion coil, which can either be purchased or made as follows: Cut some soft iron wire into 3¾ inch lengths and make up a bundle ⅜ inch in diameter. Cut out two pieces of wood, one 1½ inches square and the other 2½ inches by 1½ inches by ¼ inch. Bore ⅜-inch holes through centers, fit in the core and soak the whole in melted paraffine wax. Now wind on this two layers of No. 22 wire and run the ends out through two small holes in the larger end. This is for the primary and the vibrator, which can be bought or taken out of an old electric bell. One wire goes direct to a screw, A, at the top of the vibrator end, and the other goes to the thumb screw B. The vibrator spring is connected to C. Next wind two layers of writing paper over the primary and glue it. The secondary is next wound on. Make a small hole D in the smaller wood end and run out wire and connect to E. Wind on two and one-half to three ounces of No. 34 magnet wire evenly and connect to other terminal F. Next wind three or four layers of paper over this and glue. So much for the coil. Now cut out a piece of wood 2 inches by 1 inch by ¼ inch and fasten on two metal plates separated about ⅛ inch. Connect a wire to each plate and leave about 3 feet over. Next take a flashlight case and instead of a lamp obtain a miniature attachment plug.

To work it put the flashlight case and battery in the left trouser pocket and run the wires from the attachment plug to the primary of the coil, which is placed in a vest pocket, vibrator up. The wires from the hand-plates are run up the right sleeve and connected to the secondary of the coil. To test it, press the button of the flashlight and the buzzer on the coil should start, if not adjust it. Then place the piece of wood with the plates on the palm of the hand and you will feel the shock. When shaking hands with anyone turn the piece of wood so that when the hand is grasped the plates will touch the victim's hand and then watch results! I have used my apparatus for nearly a year and have had great fun with it.

Contributed by E. LASTER.

HINTS ON USING ODDS AND ENDS IN RADIO CONSTRUCTION.

Interest in radio experimenting centers in the ease with which efficient apparatus can be made up by the average boy, who generally has few tools and little cash. Discarded clocks, bells and batteries, and other miscellaneous material, generally classified as "junk," can be worked over into radio sets.

Zinc from old batteries, melted under charcoal, is cast into new zincs; the side binding posts from dry batteries, hacksawed off at the bottom of the slot in the head, and held in a lathe, are filed into shape for switch points. When there is no lathe, a hand drill held in a vise answers the purpose.

Carbons of old batteries are renewed by boiling in clean water. The connecting screws are very useful.

Old wire, from bell magnets, et cetera, can be used for tuner windings; if the insulation is damaged, wind a thread between turns. Sealing wax and a hot soldering iron will fasten the ends.

Old photo films, boiled until clean, make good condenser dielectrics for receiving circuits.

Hard rubber may be softened by inserting it in boiling water; form while hot. Warped pieces may be straightened by heating, and clamping between smooth boards until cold. Any tool used in woodworking will work on rubber, but must not be crowded or forced.

Instruments made of wood should have all metal parts separated from the wood by mica sheets or washers, so that at no point in the circuit does the metal rest on wood.

Use a pure silver wire for "cat-whisker" detectors; all metal parts should be silver-plated, which can be done at home with little trouble. Nickel is a loss.

Exploded cartridge shells can be worked into good detector cups.

Aerial masts can be made nicely of three by one-inch wooden strips, built in a long V shape. Latticed across in four to six-foot lengths, they are light and strong.

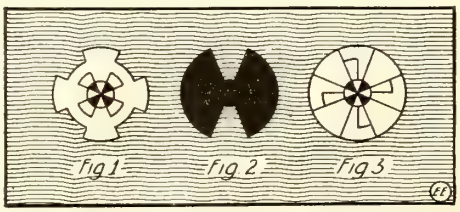
Discarded lengths of the galvanized cable used by electric companies as guy wires, when untwisted in pairs, make excellent guy wires for the ordinary mast.

Aerial ropes boiled in paraffine last longer, without stretching and shrinking from the weather.

Contributed by A RADIO BUG.

AN ELECTRIC DISC ILLUSION.

I give herewith a contribution to the *The Electrical Experimenter,* by which many wonderful and charming color illusions can be produced both day and night. The plan of construction follows: Articles necessary —A small motor, a wooden cabinet, three or four cells of battery, a switch, a sheet of metal and a piece of cardboard about 10 inches long and 7 inches wide. First of all mark out in dotted lines the two revolving color discs as illustrated in Figs. 1 and 3.



Details of Color Discs.

A sharp penknife must be used in order to trim away the edges and ends in the disc illustrated in Fig. 1. Then procure a sheet of brass or metal, mark out and cut out as shown in Fig. 2. In every one of these discs leave a small hole in the center in order to permit their fastening on the shaft of the motor loosely. Then make a sort of cabinet of wood as shown in Fig. 4. In the center of the top of the cabinet drill a small hole in order to pass the shaft of the motor through. After doing this, fasten your motor on a block of wood and again tighten this block, with motor attached, on the base of your cabinet. (See Fig. 4.) Then con-

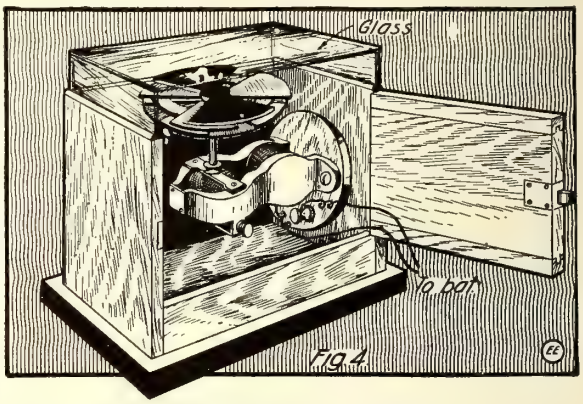


Fig. 4. Assembled Electric Disc Illusion Apparatus.

nect with batteries and switch as usual. At last paint the cardboard discs with a variety of bright hues, each one different, and fasten all three discs on the shaft protruding from the hole you drilled in the cabinet. With the addition of a plate or pane of glass the effects of the colors are greatly increased. This plate or pane can be supported by four felt or rubber-headed tacks driven in at the four corners of the cabinet. By night this outfit may also be used, but the discs must be especially made for this purpose. Cut out neatly and accurately with a sharp penknife all the curves and bends in Fig. 1 and 3, so that a mere outside frame or skeleton of the disc is left. Now take some thin tissue paper and paste it on the back of the skeletons of both discs. Then paint them with various different bright tints. On the top of the cabinet mark out and draw a circle with a compass and drill in as many holes as can be made on the circle just drawn. Then a bulb must be placed under the top, a little aside from the hole where the shaft of the motor pierces the top of your cabinet, in order to emit an even and steady light under the revolving discs. Put your bulb in connection with batteries and your outfit is complete. In order to multiply its charming effects it is advisable to place it in a very dark place. Now, when the switch is thrown, the motor begins to revolve very rapidly, at many thousand revolutions per minute, so that the discs flying around emit charming and various bright colors, owing to the bulb underneath, and when placed in some dark corner of a store window at night it will run for hours, its beautiful effects proving a sure attraction.

Contributed by W. WARNECKE, Jr.

RAIN TO ORDER.

The artificial production of rain is about to be put to the test of practice in Australia. According to the *Electrician,* London, experiments are to be carried out by J. G. Balsillie, who has for four years been conducting researches into these possibilities. A captive balloon at a height of 6,000 or 7,000 feet will be used to discharge electricity in two forms to the atmosphere. This, it is hoped, will cause sufficient ionization to provide nuclei upon which the moisture of the clouds may condense. Mr. Balsillie believes that a number of these stations set up in the path of the prevailing winds would draw all the moisture from the clouds carried by them.

OFFICIAL LIST OF LICENSED RADIO AMATEURS NOT TO APPEAR TILL SEPTEMBER, 1916, IN NEW GOVERNMENT CALL BOOK. PRESERVE THIS LIST FOR FUTURE REFERENCE.

Amateur Radio Stations Licensed by the Bureau of Navigation During the Month of September, 1915. (Continued.)

NINTH DISTRICT.

Call signal.	Owner of station.	Location of station.	Power in watts.
9VR	Eilers, Werner	Gillespie, Ill.	1,000
9VO	Esteling, David A.	1619 S. 8th St., Minneapolis, Minn.	30
9VN	Geiger, Hans F.	3151 Graceland Ave., Indianapolis, Ind.	250
9WD	Giese, Raymond C.	New London, Iowa.	1,000
9VX	Grossman, Eugene F.	Delmar, Iowa	1,000
9AK	Jumisko, Harold W.	241 Wolverine St., Laurium, Mich.	36
9WC	Kannensteine, F. M.	3400 Morgan St., St. Louis, Mo.	100
9VT	Lawrence, Harley C.	Ferrysville, Wis.	36
9GP	Mallarian, Gregory	301 S. 13th St., Fargo, N. Dak.	550
9VQ	Mason, Leroy E.	Alden, Minn.	60
9VV	Messerly, Henry	Staunton, Ill.	1,000
9AW	Niswonger, Elbert E.	R.F.D. No. 8, Fort Wayne, Ind.	220
9WB	Nolan, Guy P.	506 Ewing Ave., Kansas City, Mo.	60
9WG	Parks, Paul B.	1321 Calhoun St., Fort Wayne, Ind.	440
9WH	Reynolds, Wm. D., Jr.	3811 S. Tenth Ave., Minneapolis, Minn.	1,000
9VW	Riedy, Walter L.	237 South St., Houghton, Mich.	30
9VZ	Snarski, J. P.	1302 W. 52d St., Chicago, Ill.	30
9HB	White, Elliott A.	903 Lake St., Columbia, Mo.	1,000

Amateur Radio Stations Licensed by the Bureau of Navigation During the Month of October, 1915.

FIRST DISTRICT.

Call signal.	Owner of station.	Location of station.	Power in watts.
1US	Achin, Horace, Jr.	30 Smith St., N. Attleboro, Mass.	100
1VZ	Becker, Carl W.	56 Brookside Ave., Boston, Mass.	100
1UR	Briggs, Stuart M.	94 Walnut Pl., Brookline, Mass.	100
1RS	Buzzelle, Alfred R.	89 Kinnaird St., Cambridge, Mass.	36
1AR	Couri, Arthur N.	1 Monument St., Portland, Me.	250
1QS	Croft, Theodore C.	10 Winthrop St., Everett, Mass.	100
1AE	Dow, Harrison L.	61 Oliver St., Rockland, Me.	15
1VG	Dow, John A.	20 Woburn St., Reading, Mass.	100
1RP	Duchemin, Albert W.	26 Pond St., Greenfield, Mass.	45
1TW	Fogg, George F.	52 Upham St., Melrose, Mass.	100
1UJ	Frost, Edgar W.	2 Sheffield St., Pepperell, Mass.	100
1PR	Golder, John	1 Ivy St., Boston, Mass.	100
1WI	Grant, Alfred A.	571 Washington St., Brighton, Mass.	100
1KX	Holt, Clarence J.	26 Trenton St., Melrose, Mass.	40
1RA	Hood, Ralph S.	7 Ash St., Danvers, Mass.	100
1WF	Lefave, Stanley J.	130 Tremont St., Melrose, Mass.	100
1VK	Lynn Eng. High School	Highland Sq., Lynn, Mass.	1,000
1LC	Mass. Inst. Technology.	Boston, Mass.	500
1VF	Mayer, Arthur W.	7 Chestnut St., Jamaica Plain, Mass.	100
1VD	McMahon, John F., Jr.	56 West Ave., South Norwalk, Conn.	100
1SQ	Morrison, H. R.	137 Ingham St., Willimansett, Mass.	100
1FB	Saunders, Frank	Richmond, Me.	300
1QU	Shortis, John	5 Chelsea St., Charlestown, Mass.	100
1VS	Steadman, Robt. C.	31 Park Road, Brockton, Mass.	100
1TA	Tucker, Cecil A.	21 Church St., Lynn, Mass.	27
1VA	Wickes, Henry W.	Pleasant St., Winthrop, Mass.	100

SECOND DISTRICT.

Call signal.	Owner of station.	Location of station.	Power in watts.
2EG	Aranyi, Egmont	123 W. 112th St., New York, N. Y.	10
2GL	Ashley, George	Chatham, N. Y.	500
2DL	Bangert, V. F., Jr.	34 Orchard St., Jamaica, N. Y.	24
2CZ	Becker, Frank	12 Callister St., New York, N. Y.	440
2GF	Brockman, F. C.	226 Walnut St., Roselle Park, N. J.	700
2FQ	Connor, Harold G.	827 3d Ave., North Troy, N. Y.	28
2CF	Derx, Martin, Jr.	253 Vernon Ave., Brooklyn, N. Y.	720
2EZ	Donohue, Peter J.	103 W. 60th St., New York, N. Y.	30
2FK	Freure, Richard W.	439a McDonough St., B'klyn, N. Y.	30
2GR	Gardell, Emil C.	Oakhurst, N. J.	500
2BQ	Guild, Baldwin	495 Mt. Prospect Ave., Newark, N. J.	200
2EV	Hajoz, Eugene	626 Trinity Ave., New York, N. Y.	550
2BO	McIntire, Meylert A.	1127 Avenue G, Brooklyn, N. Y.	500
2GM	Moss, Sidney W.	56 Taylor Pl., South Orange, N. J.	500
2GI	Murphy, Dennis	9 Ingram St., Yonkers, N. Y.	30
2DQ	Porter, Roland	169 E. 74th St., New York, N. Y.	10
2CD	Robbins, Wm. E., Jr.	614 5th Ave., Upper Troy, N. Y.	27
2AH	Roche, Walter J.	2 Irving Pl., Jamaica, N. Y.	1,000
2AU	Schram, John, Jr.	283 E. 32d St., Brooklyn, N. Y.	60
2BI	Slater, Harry	156 19th St., Brooklyn, N. Y.	—
2FM	West, Gilmore C.	59 6th Ave., Long Branch, N. J.	225

THIRD DISTRICT.

Call signal.	Owner of station.	Location of station.	Power in watts.
3CY	Biser, Marx H.	Middletown, Md.	25
3KE	Brubaker, John W.	200 W. 16th St., Philadelphia, Pa.	500
3BA	Carrington, Roland	347 Camel St., Baltimore, Md.	36
3IW	Fisher, John T.	136 York Ave., W. Cape May, N. J.	36
3JV	Gardner, James A.	14 1st Ave., West Catasauqua, Pa.	24
3EX	Gray, Karl F.	113 Northampton St., Easton, Pa.	500
3IS	Hartley, Milton E.	635 E. St. N.E., Washington, D. C.	50
3KP	McKinley, Richard S.	218 Lansdowne St., Wayne, Pa.	100
3KG	Patterson, John E.	2835 N. Bailey St., Philadelphia, Pa.	60
3JA	Presbrey, Victor E.	Vineland, N. J.	24
3GD	Sener, C. Edward, Jr.	2706 24th St., N.E., Washington, D.C.	60
3IU	Silver, Paul B.	210 Lansdowne St., Philadelphia, Pa.	250
3IP	Williamson, Chas. M.	Hampton, Va.	50

FOURTH DISTRICT.

Call signal.	Owner of station.	Location of station.	Power in watts.
4AJ	Featherton, Joe A.	Honea Path, S. C	1,000
4BS	Henshaw, Howard	Miami, Fla.	24
4BI	James, F. Leslie	211 Lee St., Tampa, Fla.	20
4BO	Megee, Benjamn R.	63 Mansfield St., Atlanta, Ga.	550
4BW	Newell, William F.	828 5th Ave., N., St. Petersburg, Fla.	250

FOURTH DISTRICT.

Call signal.	Owner of station.	Location of station.	Power in watts.
4BV	Saeger, Raymond A.	Ankona, Fla.	170
4CW	Taft, Robert B.	105 Rutledge Ave., Charleston, S. C.	495
4BP	Whitaker, A. Klein.	210 Stanton St., Bradentown, Fla.	500
4BM	Williams, Emory C.	Kirdwood, Ga.	770

FIFTH DISTRICT.

Call signal.	Owner of station.	Location of station.	Power in watts.
5DH	Andress, Max	735 N. Robinson St., Cleburne, Tex.	18
5DI	Hanz, Harry W.	310 Bridge St., New Braunfeld, Tex.	250
5DJ	Richard, Chas. L.	1004 Government St., Mobile, Ala.	500

SIXTH DISTRICT.

Call signal.	Owner of station.	Location of station.	Power in watts.
6CV	Anderson, Donald S. C.	154 Texas St., Redlands, Cal.	100
6AW	Cullen, Paul K.	R.F.D., No. 1, Long Beach, Cal.	600
6LU	Oliver, Leslie H.	1116 Catalina Ave., Pasadena, Cal.	165
6DV	Taenzer, Ernest M.	801 Brent Ave., S. Pasadena, Cal.	330
6CX	Whitehead, Stanley K.	138 N. Ohio St., Los Angeles, Cal.	330

SEVENTH DISTRICT.

Call signal.	Owner of station.	Location of station.	Power in watts.
7AC	Dailey, A. C.	3915 Colby St., Everett, Wash.	1,000
7DO	De Guire, Olfan	Silverton, Ore.	250
7FF	Farris, Frank E.	1010 Spring St., Olympia, Wash.	450
7LJ	Harder, Louis	360 Hancock St., Portland, Ore.	220
7JI	Harding, Jas. R.	343 Commercial St., Salem, Ore.	1,000
7BQ	Howard, Cecil C.	408 Benton St., Portland, Ore.	250
7JL	Jones, Lloyd W.	134 E. 45th St., Portland, Ore.	124
7KR	Keefe, Robert M.	121 Avenue D, Snohomish, Wash.	140
7WJ	Kennedy, William	Tillamook, Ore.	100
7HL	Longmire, Harold D.	408 32d St., South, Tacoma, Wash.	495
7DL	Mason, Dwight A.	817 N. 13th St., Tacoma, Wash.	500
7JQ	Ray, James	2028 6th Ave., Seattle, Wash.	440
7AP	Rosedale, Archie E.	267 9th St., Astoria, Ore.	100
7MA	Wiley, Irving R.	1214 E. Madison St., Portland, Ore.	50
7BW	Williams, Chas. E.	8326 13th Ave., N.W., Seattle, Wash.	250
7CW	Willius, Charles	1400 E. Stark St., Portland, Ore.	124

EIGHTH DISTRICT.

Call signal.	Owner of station.	Location of station.	Power in watts.
8RL	Alexander, Frank	34 Asbury St., Rochester, N. Y.	12
8NU	Barker, Gilroy	2901 W. Liberty Ave., Dormont, Pa.	500
8QE	Barnhart, Walter	Beaver, Pa.	250
8KF	Beck, Frank G.	119 Penn. Ave., Greensburg, Pa.	750
8NJ	Crumbie, Goodwin B.	Plymouth, Mich.	36
8MQ	Duff, Cuthbert	Norwood, Ohio	50
8QK	Gould, Henry W.	Oberlin, Ohio	1,000
8PZ	Guy, Fred E.	24 Jewel St., Rochester, N. Y.	27
8OG	Hinton, Don	Cambridge, Ohio.	36
8LJ	Linxweiler, Carl J.	140 Eagle St., Dayton, Ohio	20
8HI	McCracken, Harold J.	1540 12th St., Detroit, Mich.	500
8NQ	McMunn, J. Homer	Cambridge, Ohio.	250
8QM	Milyo, Stephen	Mount Carmel, Pa.	24
8NE	Mosteller, Floyd	E. Stroudsburg, Pa.	500
8KV	Schramm, Joseph H.	927 Highland Ave., Pittsburgh, Pa.	48
8DC	Schulder, Arthur	6110 Utica Ave., Cleveland, Ohio	420
8KL	Smith, Raymond	Tippecanoe City, Ohio.	60
8GK	Tomlinson, Geo. E.	520 Crawford St.,Grand Rapids,Mich	27

NINTH DISTRICT.

Call signal.	Owner of station.	Location of station.	Power in watts.
9GA	Case, Henry W.	Wheeler, Ill.	33
9GF	Eyth, Hector G.	2325 Arapahoe St., Denver, Colo.	12
9RI	Flesvig, Henry	743 W. 26th St., Chicago, Ill.	500
9JU	Gisseler, Herman	2828 Fletcher St., Chicago, Ill.	150
9HT	Gleichman, Walter C.	2006 Fulton Ave., Evansville, Ind.	275
9JS	Goodnetter, Elmore F.	1500 Grand Ave., Racine, Wis.	250
9SR	Hogan, Lee	458 11th Ave., Milwaukee, Wis.	18
9HY	Kerfer, Allen W.	Ashland, Ky.	250
9GJ	Lavender, Edwin N.	7363 Maple Blvd., Maplewood, Mo.	550
9GE	McKee, Myron J.	2213 N. New Jersey St., Indianapolis	275
9GS	Morgan, Berwyn E.	506 E. Cherry St., Watseka, Ill.	36
9GW	Rock, Burnham S.	5921 Winthrop Ave., Chicago, Ill.	550
9GB	Taylor, Wm. B., Jr.	6638 Kenmore Ave., Chicago, Ill.	550
9IS	Wendell, Raymond B.	908 Clark St., Evanston, Ill.	363
9II	Wilshusen, Wilmer L.	Stafford, Kans.	750

Amateur Radio Stations Licensed by the Bureau of Navigation During the Month of November, 1915.

FIRST DISTRICT.

Call signal.	Owner of station.	Location of station.	Power, kilowatts.
1AAT	Allen, Laurence H.	60 Dean St., Attleboro, Mass.	.5
1AAE	Baker, Warren F.	2 Baker Pl, Dorchester, Mass.	.5
1AAL	Burt, Jairus F.	66 Pine St., Pittsfield, Mass.	.5
1AAV	Carter, Geo. T., Jr.	686 Massachusetts Ave., Boston	.5
1AAO	Cheever, Walter G.	6 Aldersey St., Somerville, Mass.	.5
1AAJ	Custeau, Harry G.	24 Clark St., Cambridge, Mass.	.5
1AAF	Drew, Wililam E.	324 Central Ave., Auburndale, Mass.	.5
1AAY	Etter, Earle F.	25 Bickerstoff St., Boston, Mass.	.5
1AAK	Fowle, Herbert L.	Woodward Ave., Reading, Mass.	.5
1AAG	Ghen, Melville W.	64 First St., Melrose, Mass.	.5
1AAI	Gray, Arthur	59 Regent St., Roxbury, Mass.	.5
1VT	Hill, William J.	691-A Columbia Rd.,Dorchester, Mass	.5
1AAB	Massey, John C.	3 Whitwell Ave., Newport, R. I.	.5
1AAN	McNamara, Fred'k W.	23 Alpine St., Arlington, Mass.	.5
1UY	Merritt, Hyland E.	18 Lowden Ave., Somerville, Mass.	.5
1AAD	Needham, Raymond W.	10 Grove St., Pittsfifield, Mass.	.5
1QJ	Noble, Lewis C.	35 Wdln Ave., Wellesley Hills, Mass	.5
1VY	Park, Francis E., Jr.	359 Main St., Stoneham, Mass.	.5
1AAH	Pinnington, William	71 Jouvett St., New Bedford, Mass.	.5
1AAC	Prinz, Julius C.	5 Charles St., Newport, R. I.	.5
1BE	Wadsworth, Philip S.	8 Hanover St., Portland, Me.	.5
1VP	Whipple, Harold B.	172 Park St., Medford, Mass.	.5
1AAW	Winant, Alvin C.	West Medway, Mass.	.5

SECOND DISTRICT.

Call signal.	Owner of station.	Location of station.	Power, kilowatts.
2FO	Blanchard, Wesley S.	170 Jersey St., New Brighton, N. Y.	.5
2HV	Collignon, Francis A.	352 Willett Ave., Port Chester, N.Y.	.5
2HT	Dunn, Alan C.	62 Edgecombe Ave, New York, N.Y.	.5
2ID	Miller, John W., Jr.	119 Smith St., Peekskill, N. Y.	.5
2HJ	Muller, Julius A., Jr.	301 Union Ave., Mt. Vernon, N. Y.	.5
2IV	Smith, Nelson M.	143 Horton Ave., Port Chester, N.Y.	.5
2HS	Stewart, Douglass	90 N. Broadway, Yonkers, N. Y.	.5

(To be continued.)

HOW TO MAKE IT

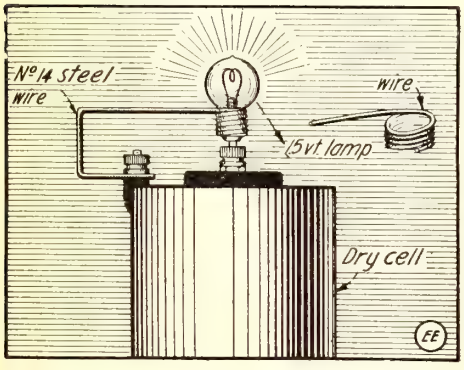
This department will award the following monthly prizes: FIRST PRIZE, $3.00; SECOND PRIZE, $2.00; THIRD PRIZE, $1.00.
The idea of this department is to accomplish new things with old apparatus or old material, and for the most useful, practical and original idea submitted to the Editors of this department, a monthly series of prizes will be awarded. For the best ideas submitted a prize of $3.00 will be given; for the second best idea a $2.00 prize, and for the third best a prize of $1.00. The article need not be very elaborate, and rough sketches are sufficient. We will make the mechanical drawings.

SECOND PRIZE $2.00.

A HOME-MADE BATTERY LAMP.

Bend one end of a 6-inch piece of No. 22 steel wire into a spiral large enough to allow a miniature lamp to be screwed into it. Do the same to the other end, only make the loop just large enough to slip over a zinc binding post on a dry cell. It is best to twist the ends. About 1½ inches from the large loop bend the wire at right angles. About ¼ inch from the smaller loop bend the wire so that it makes a square corner. Put the fixture on an ordinary dry cell. The bottom contact of the lamp should not quite touch the carbon binding post. By holding the battery in a horizontal position with the hand and by merely pressing on the wire the light will burn brightly. Although this design is simple it is quite efficacious.

Contributed by SHELBY BLONG.



Battery Lamp Holder and Switch Formed from Piece of Steel Wire. Beat It!

AN EMERGENCY FUSE PLUG.

While experimenting with the 110-volt house lighting current recently I accidentally blew out the fuse. As I had no extra ones on hand, and no time to go to town after another, I decided to make one the best way I could. Procuring an old burnt-out 16 candlepower carbon lamp I broke the bulb and removed all the pieces of glass from the base. I also took out the broken filament, which left the brass base with a small glass tube holding the two platinum wire supports. The ends of these supporting wires I cleaned with a file. I then carefully twisted the wires together and put a drop of solder on the joint.

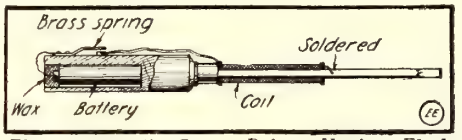
After throwing open the switch I removed the regular fuse plug, containing the burnt-out fuse, and screwed my home-made fuse in, which I found to work excellently. It is obvious, however, that the switch should be open when inserting this makeshift fuse, as the brass base offers no insulation against a shock.

Contributed by MURIEL MURTAUGH.

FIRST PRIZE $3.00.

IMPROVED ELECTRO-MAGNETIC SCREW DRIVER.

Bore a hole into the handle of the screw driver the size of the cell used in a vest pocket flashlight battery. This hole will be about 3 inches deep by ⅝ inch in diameter. Solder a piece of fine wire to one pole of



Electro-magnetic Screw Driver Having Flash-light Battery in Handle.

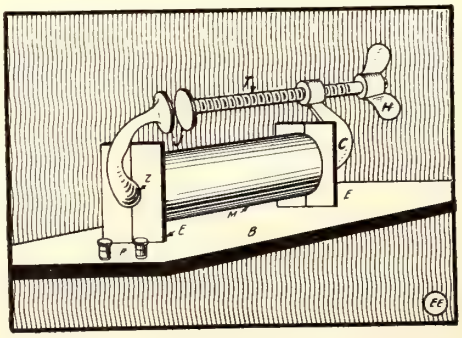
the cell, and insert it into the handle far enough to come in contact with the inner end of the screw driver blade. Fill in the end with a wood plug and bring the end of wire through its center. With small brass screws fasten a thin brass strip to the handle and attach the wire to it. Then put another screw into the handle and attach a wire from the coil to it. The other end of the wire is soldered to the screw driver itself.

Having the battery in the handle of the tool will make it more useful and easier to carry than the one which was previously described in these columns, where the plan was to carry two or more standard dry cells with the screw driver, I believe.

Contributed by C. A. SHEPHARD.

ADJUSTABLE MAGNETIZER MADE FROM WOOD CLAMP.

An ordinary furniture clamp of suitable size is fitted with two square wooden pieces, cut as at Z, in the figure. These pieces are placed around the shank of the clamp to serve as magnet ends. The split blocks are then joined with glue and allowed to dry. Wire of the proper size to obtain the desired magnet strength is next wound neatly between the ends E, E. The magnetizer is glued to a suitable base and is supplied with binding posts P. In using



An Adjustable Magnetizer Made from Iron Wood Clamp.

it the handle H is rotated until the desired distance is obtained.

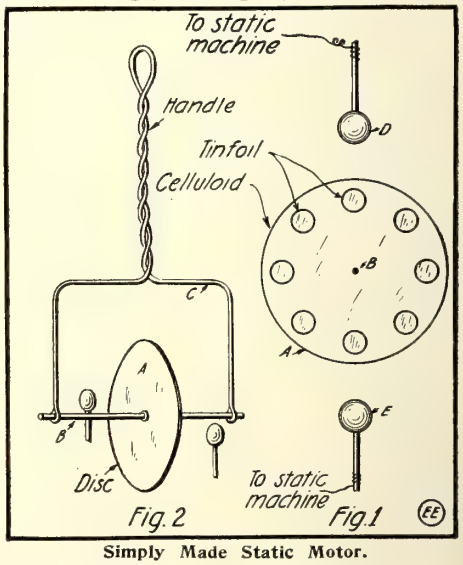
Contributed by A. D. R. FRASER.

THIRD PRIZE $1.00.

A SIMPLE ELECTROSTATIC MOTOR.

The little motor illustrated and described below is entertaining as a scientific toy and also serves to show how motion may result from an electrostatic field. It has the further advantage of costing practically nothing.

Fig. 1 shows the moving parts, which consists of a disc of stiff celluloid A, two inches in diameter. A large hatpin B (minus the head) is passed through the center and forms an axle, projecting an equal distance on either side of the disc. This may be secured with two little dabs of sealing wax, carefully applied. Eight small circles of tinfoil are stuck at equal distances near the edge, either gum, shellac, varnish



Simply Made Static Motor.

or celluloid cement being used as an adhesive. If the disc is suspended so as to be free to revolve, and brought between the discharging balls of a Wimshurst machine D and E, separated to a distance of about three inches, it will rotate at a considerable speed upon working the machine. Usually the motor starts at once, but the writer has found that it is sometimes necessary to start it with the finger if the tinfoil circles happen to be exactly in line with the electrodes.

A convenient form of support is shown in Fig. 2, where A represents the celluloid disc, B the steel axle and C a handle bent from a piece of thin copper wire. The two arms supporting the axle should be at least three inches long and as wide apart as the length of the axle admits. If preferred, a little stand may be made with a wooden base and two uprights, the height of the latter being adjusted to suit the Wimshurst machine with which the motor is to be used.

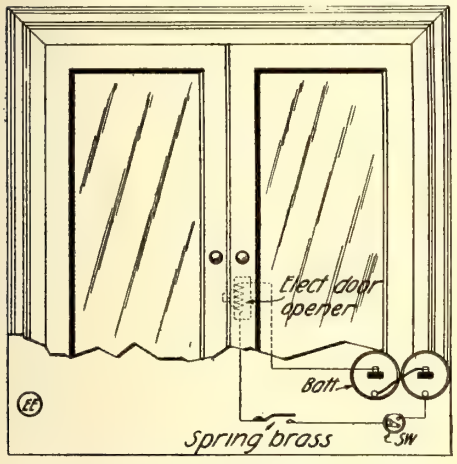
Contributed by H. I. GRAY.

NOVEL USE OF DOOR OPENER.

Having frequently to go in the cellar and return with my arms full, I devised the following scheme whereby I can open the door without emptying my arms, although to a stranger the door is securely locked.

An electric door opener was put on the door and connected as an ordinary door opener, the only difference being that instead of going to a push button the wires led to a secret contact of spring brass, which was put in an out-of-the-way corner under the carpet.

When I wish to open the door I step on



Foot Operated Electric Door Opener.

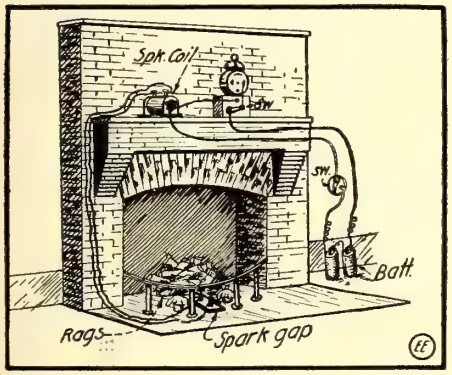
the secret contact and the push-out spring opens the door.

Contributed by CARL T. LUDWIG.

AN ELECRIC FIRE STARTER.

This electric fire starter prevents having to get up on a cold morning to start same.

All that is required is a spark coil of any size, enough batteries to operate the coil, an alarm clark, a battery switch, a box 8x3 inches, a tin pan, two cork stoppers and two needles. The stoppers are fastened to the bottom of the pan and the needles stuck through the corks, making a spark gap. The gap is connected to the coil and set under the grate. Some rags are bundled up tight and soaked in gasoline or turpentine and put just under the gap.



Alarm Clock and Spark Coil Start Fire in Morning. Spark Gap Should Be Protected With Asbestos to Prevent it Being Burned Up.

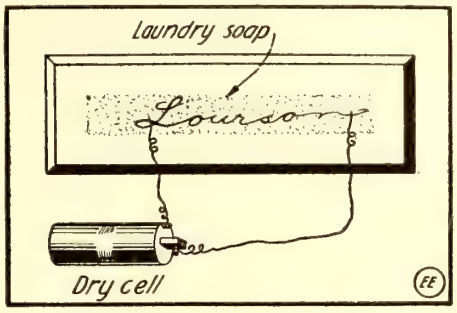
Over the rags are placed some splinters, and then wood and coal.

The alarm clock is wound and set and a loop put in a string over the alarm thumbscrew on the back of the clock. The other end is attached to a small switch coming from the batteries. The other wire from the batteries goes to the spark coil, and the opposite end of the switch connects to the coil. When the clock goes off, the thumbscrew will revolve, close the switch and start the coil. The spark will light the rags under the grate and start the fire.

Contributed by J. WESLEY BROWN, JR.

HOW TO DO ELECTRICAL ETCHING.

Following is a little experiment which



Simple Electric Etching Scheme.

can be successfully carried out by carefully following the directions herewith given. It will prove quite interesting, and will insure the object thus etched against theft, etc.

A few cents' worth of bluestone is procured and dissolved in one part of water, to which is added two tablespoonfuls of salt. Clean well the object to be etched. Next, with a piece of ordinary yellow laundry soap, coat the surface until a thin film of the same is applied. Then take a sharp-pointed pin and scrape, in one continuous path, the name or initials, etc., desired to be etched in and pour on the solution until the object to be etched is covered. The drawing explains at a glance the next step, and that is to connect a dry battery, with both wires from zinc and carbon in the solution. Leave thus for a few minutes.

Then rub off the soap with a rag, and the name, initial or whatever was scraped on the object, will appear. It is copper-coated and "etched in."

This little hint is invaluable for the laboratory or shop, where the owners of tools often lose, miss and hunt for their instrument. This mark is indelible and cannot be altered or taken out.

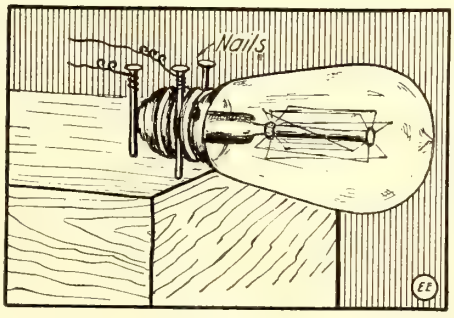
Contributed by WILLIAM WARNECKE, JR.

THE SIMPLEST LAMP SOCKET.

This emergency lamp socket is made in three seconds by driving two nails into the side of a piece of wood the right distance apart for the base of a lamp bulb to screw between, and one nail placed ¾ inch distant and at a point perpendicular to the other two.

A connection is made to one of the side nails and the other connection is made to the back nail. See cut.

Contributed by W. F. ALLSTON.



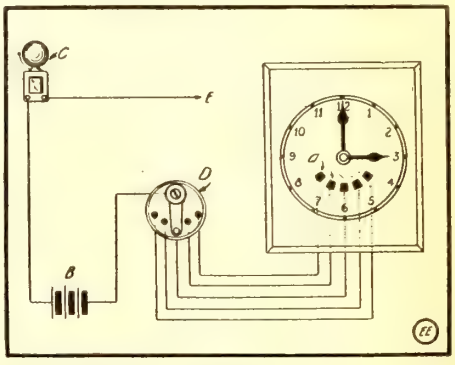
Simplest Lamp Socket. Made from Three Nails.

(If a lamp "socket" can be made of less material than the above we would like to see it!.—Ed.)

A PRACTICAL ELECTRIC ALARM CLOCK.

This is a rough but practical way in which to make a useful alarm clock.

At A are especially shaped brass or tin contacts. B is the battery, C a bell. D is the switch controlling the points on the clock. E is the wire which is to be connected to frame of clock, and completes the circuit when the hour hand strikes the metal points A. Caution: Let only the hour hand strike the contacts. The points will have to be adjusted so as to make the bell ring at the correct time, and of the proper height to allow the hand to pass over them after making contact. The



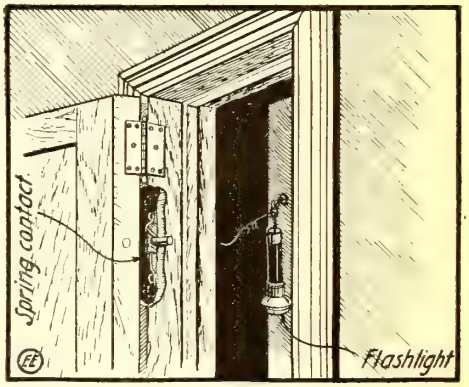
Useful Alarm Attachment for Any Clock. Switch Shown Permits Ringing Bell at Any Desired Time.

switch D may be placed in any convenient place. Another switch may also be put in series with the bell and placed close to the bed to facilitate the turning off of the bell without getting up. This switch should remain closed normally. I installed one of these clocks recently and it works very successfully. Contributed by

NORMAN W. BROWN.

FLASHLIGHT FOR ILLUMINATING DARK CLOSETS.

An ordinary flashlight can often be handily arranged so it will light a dark closet, wardrobe or pantry. It is supported on a hook or a nail inside of the closet, and a spring switch with extending rod, similar to a burglar alarm switch, may be placed on



Door-Controlled Spring Switch Used to Close Flashlight Circuit When Closet Door is Opened: Extinguishes It When Door is Closed.

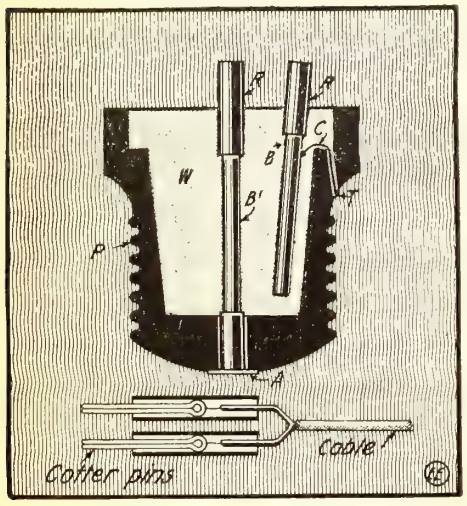
the door jamb. When the door is closed the spring will be separated and the light will be extinguished, but when the door is opened the spring switch closes, lighting the closet or pantry, as the case may be. Ordinary bell wire will be found suitable for making connections between the switch and the flashlight. This form of illumination will be found efficacious in solving many other lighting problems of a similar nature.

Contributed by B. J. SARTER.

USEFUL ATTACHMENT PLUG.

This plug may be made from an old plug type fuse with the brass top removed. The thread and one brass tube should be connected by a wire through the channel usually found on such plugs. To connect wires to this plug, cotter pins of suitable size should be employed. The accompanying sketch depicts the different parts of the plug.

At P is an old fuse plug; B¹, brass tube soldered to contact rivet A; B, brass tube with wire from thread of "plug" soldered to it; C, connecting wire; T, connecting



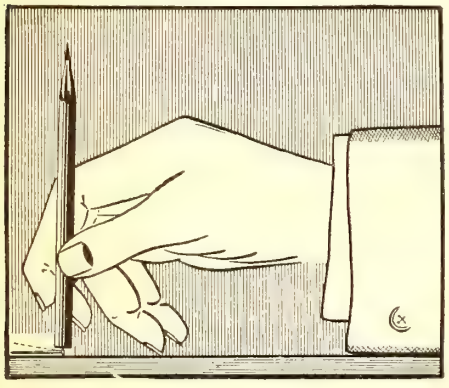
Separable Attachment Plug Made Out of Old Fuse Plug.

wire soldered to thread; R R, rubber tube to insulate B¹ and B; W, sealing wax.

Contributed by A. D. R. FRASER.

MORSE SOUNDER FROM A "PIN."

As a reader of your interesting review I beg to enclose the sketch of an idea of mine which up to the present I believe is not known, and perhaps it may be of interest to students of the Morse code. Place the bottom part of a pencil on the head of a small pin (on a table or other hard surface) and move the pencil, as shown in diagram, which will actuate as a sounder



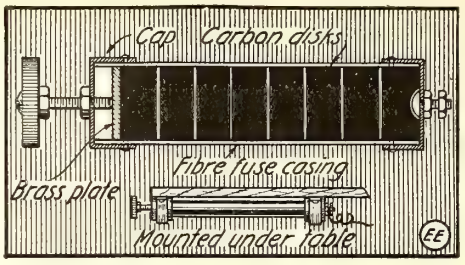
A "Pin" Sounder That Works! Try It.

for practising the Morse code. Contributed by ANTONIO CORNISH-BESA,
Valparaiso, Chile.

A CARBON RHEOSTAT IN A CARTRIDGE FUSE SHELL.

Carbon rheostats are slowly but surely finding their place in the electrical field. Working on the principle of imperfect contact, they have the fine adjustment of a water rheostat without the attendant gases, while they are as easy to handle as a metal resistance and will carry a heavier current than a wire rheostat of the same weight, besides being very compact.

They can be made cheaply and in any size for your needs, but I will limit my description to a small one suitable for use in charging storage batteries, controlling small motors, or as a ballast for a small arc lamp.



Rheostat Composed of Carbon Discs in Fuse Shell.

Obtain a blown fuse cartridge shell whose internal diameter is the same as the diameter of the round carbon rods you should procure from some old, dry cells. Remove one fuse cap, take out the fireproof filling and any wires remaining at the ends.

Now take the carbon rod and carefully cut it up into ¼-inch lengths. The cuts should be straight across, so the discs will lay close together inside the tube. These discs are piled on top of one another till the tube is nearly full.

Connections are made to the two caps, one of which has an adjusting screw threaded through it to enable the operator to regulate the pressure between the discs.

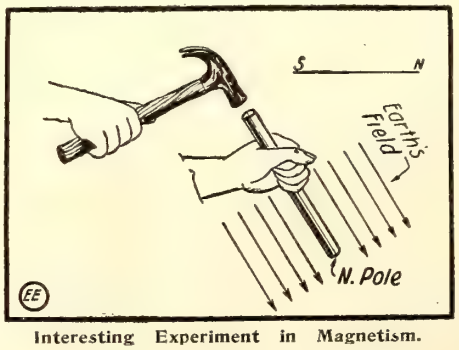
The sketch makes a lengthy explanation unnecessary, but it is advisable to use the system of mounting suggested, as otherwise when pressure would be applied by turning the knob the caps would be forced off the end of the fiber tube.

Contributed by
THOS. W. HANSON.

CURIOUS EXPERIMENT IN MAGNETISM.

One of the simplest yet most puzzling experiments in magnetism can be performed with a rod of machine steel held in the earth's magnet field. It is well known that it is difficult to free iron completely of magnetism. That is, it is almost impossible to completely demagnetize it. For this experiment a piece of very soft machine steel is desirable.

If a small compass is brought near one end, the North seeking pole will be found to be either attracted or repelled. At the other end the reverse condition will be obtained. Hold the rod of iron in the earth's field, whose general direction is North and South, and strike one end with a hammer, as perceived from illustration. The end of the rod which is pointed North will become a North magnetic pole. If the rod is reversed and a blow struck on the end with the hammer, the magnetism in the rod will be found reversed. This is tested for by means of a compass needle.

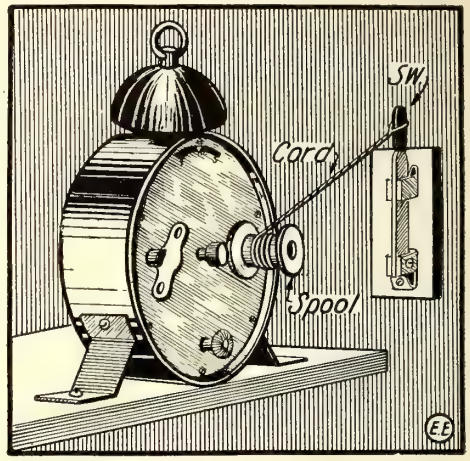


Interesting Experiment in Magnetism.

As the earth's field is not parallel with the surface of the earth, better results will be obtained if the rod is pointed toward the earth, at an angle of say 60 degs., care being taken to keep the rod in a general North and South direction.

NOVEL ELECTRIC TIME SWITCH.

First procure an alarm clock. Take the winding key off the alarm pinion shaft and fasten a spool to it by means of a brass bushing. Next obtain a common knife switch. Arrange the clock and switch as



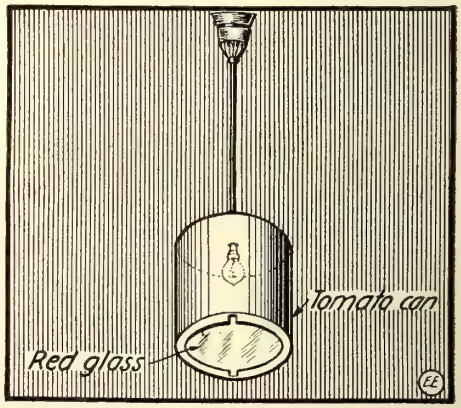
Alarm Clock Opens Switch at Any Desired Time.

shown in sketch. Fasten the cord to the switch and then close it; next wind the alarm and fasten the other end of the cord to the spool. Wind the alarm and set at the desired time for turning off the switch, and when the alarm goes off the switch will be pulled open. This switch has been used with much success on store window lights.

Contributed by J. T. DRAIN.

RED LIGHT FOR PHOTO DEVELOPING ROOM.

A tomato can when opened leaves a rim



Ruby Lamp Made Out of Tomato Can.

about ⅜ inch wide. Flatten this rim and cut out notches for passing a red glass disc through. Put a hole in center of the top cover for wire to incandescent light, as shown in drawing.

Contributed by
NICHOLAS ACCARDI.

Connect a Geissler tube across your primary leads. It will protect the set from heavy static surges and lightning. You can't expect to make a good joint by merely twisting the wires—solder them.



Under this heading we will publish every month useful information in Mechanics, Electricity and Chemistry. We shall be pleased, of course, to have our readers send us any recipes, formulas, wrinkles, new ideas, etc., useful to the experimenter, which will be duly paid for, upon publication, if acceptable.

FORMULA NO. 18.

Solders.

1. *Plumbers' Solder.—Lead,* 2 parts; *Tin,* 1 part.

2. *Tinmen's Solder.—Lead,* 1 part; *Tin,* 1 part.

3. *Zinc Solder.—Tin,* 1 part; *Lead,* 1 to 2 parts.

4. *Spelter Solder.*—Equal parts *Copper* and *Zinc.*

5. *Glazier's Solder.—Tin,* 3 parts; *Lead,* 1 part.

6. *Solder for Copper.—Copper,* 10 parts; *Zinc,* 9 parts.

7. *Brass Solder.—Copper,* 61.25 parts; *Zinc,* 38.75 parts.

8. *Brass Solder, White.—Copper,* 57.41 parts; *Tin,* 14.60 parts; *Zinc,* 27.99 parts.

9. *Black Solder.—Copper,* 2 parts, *Zinc,* 3 parts; *Tin,* 2 parts.

10. *Cold Brazing Without Fire or Lamp. —Fluoric Acid,* 1 oz.; *Oxy-muriatic Acid,* 1 oz.; mix in a lead bottle. Put a chalk mark each side where you want to braze. This mixture will keep about six months in one bottle.

11. *To Solder Iron to Steel or Either to Brass.—Tin,* 3 parts; *Copper,* 39½ parts; *Zinc,* 7½ parts. When applied in a molten state it will firmly unite metals first named to each other.

12. *Plumbers' Solder.—Bismuth,* 1 part; *Lead,* 5 parts; *Tin,* 3 parts; is a first-class composition.

13. *Solder for Brass That Will Stand Hammering.—Brass,* 78.26 parts; *Zinc,* 17.41 parts; *Silver,* 4.33 parts; add a little chloride of potassium to your borax for a flux.

14. *Solder for Steel Joints.—Silver,* 19 parts; *Copper,* 1 part; *Brass,* 2 parts. Melt all together.

15. *Hard Solder.—Copper,* 2 parts; *Zinc,* 1 part. Melt together.

16. *Solder for Brass.—Copper,* 3 parts; *Zinc,* 1 part; with *Borax.*

17. *Solder for Copper.—Brass,* 6 parts; *Zinc,* 1 part; *Tin,* 1 part; melt all together well and pour out to cool.

18. *Solder for Iron.*—The best solder for iron is good tough brass with a little borax.

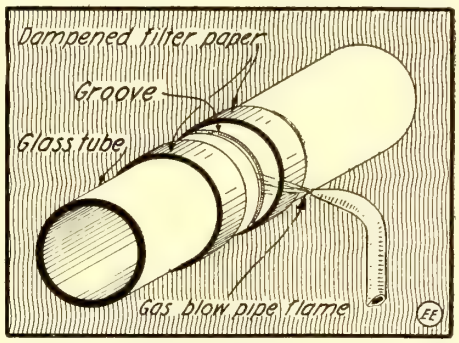
N. B.—In soldering, the surfaces to be joined are made perfectly clean and smooth, and then covered with sal-ammoniac, resin or other flux, the solder is then applied, being melted on and smoothed over by a tinned soldering iron.

Soldering Fluid.—Take 2 oz. *Muriatic Acid;* add *Zinc* till bubbles cease to rise; add ½ teaspoonful of *Sal-Ammoniac.*

S. G.

HOW TO CUT GLASS TUBING.

To many, or rather most experimenters, it is a difficult thing to cut glass tubing larger than a half inch in diameter. Sizes under this can be broken after being cut or nicked slightly with a file. The method I will explain is that used in most chemical laboratories. To illustrate, say the tube is about an inch and a half or so in diameter. The required length of tubing is measured off and then a groove is cut around the tube with the corner of a file. This must be rather deep. Then a piece of filter paper is folded so as to be about two inches wide and long enough to go around the tube. The paper is then moistened. This and a similar piece are placed one on each side of the groove, leaving about a quarter of an inch between the two. A flame from a bunsen burner or blow pipe is then applied to the groove and it will be found that the tube breaks evenly along the file cut. Another method that can be used on smaller tubing, about half inch in diameter, is to make a cut as described and then apply a red hot piece of iron to one spot on the cut.



Easy Way to Cut Glass Tubing.

(A very simple method to accomplish the above is the following: Take a thick piece of string and soak it well in alcohol. Tie it around the part where tube is to be cut. Now light the string. The second it extinguishes dash a drop of cold water on it. A sharp, even break of the tube is the result. We have thus "cut" off the necks of large bottles.—*Editor.*)

Contributed by SYBEREN NYDAM.

CEMENTING GLASS TO METALS.

(1) A cement of great adhesive property, particularly serviceable in attaching the brass mountings on glass lamps, as it is unaffected by petroleum, may be prepared by boiling 3 parts of rosin with 1 part of caustic soda and 5 parts of water, thus making a kind of soap which is mixed with one-half of its weight of plaster of Paris. Zinc white, white lead, or precipitated chalk may be used instead of the plaster, but when they are used the cement will be longer in hardening.

(2) A cement for such purposes as fixing metal letters to glass windows consists of copal varnish 15 parts, drying oil 5 parts, turpentine 3 parts, oil of turpentine 2 parts, liquefied marine glue 5 parts. Melt in a water bath and add 10 parts dry slaked lime.

(3) Brass letters may be securely fastened on glass windows by the following recipes: Litharge 2 parts, white lead 1 part, boiled linseed oil 3 parts, gum copal 1 part. Mixed just before using this forms a quick drying and secure cement.

(4) One pound of shellac dissolved in a pint of strong methylated spirit, to which is to be added 1-20 part of a solution of india rubber in carbon bisulphide.

(5) Take 2 ozs. of a thick solution of glue and mix with 1 oz. of linseed oil varnish, or ¾ oz. of Venice turpentine. Boil together, agitating until the mixture becomes as intimate as possible. The pieces cemented should be fastened together for a space of 48 to 60 hours.

(6) One of the best cements for uniting glass to other substances is prepared by putting the best and purest gum arabic into a small quantity of water and leaving it till next day, when it should be of the consistency of treacle. Calomel (mercurous chloride or subchloride of mercury) is then added in suitable quantity, enough to make a sticky mass being well mixed on a glass plate with a spatula. No more is to be made than that required for immediate use. The cement hardens in a few hours, but it is wiser to leave it for a day or two. To insure success it is necessary to use only the very best gum; inferior sorts are absolutely useless.

(7) Before glass can be soldered to metal it must be "quicked" upon the side that is to be soldered. The "quicking" process is similar to, if not identical with, the method of silvering a looking glass. When the glass is "quicked" it may be readily soldered to the metal, using Venice turpentine or chloride of zinc as a flux.

(8) Sixty parts starch, 100 finely pulverized chalk are made into a mixture with equal parts of water and spirit, and the addition of 30 parts Venice turpentine, taking care to agitate the mass with a stick, so as to insure its homogeneity.

(9) Four parts glue melted with the least possible quantity of water, 1 part Venice turpentine will resist moisture.

(10) That solder in some form adheres to glass is well known and practised by the makers of fictitious jewelry. These are made up of pieces of black glass, cut and polished, and fairly soldered on to metal plates. By breaking one of these across it will at once be seen how strong the adherence really is. If the work has been well done the pieces of glass do not fly off, but are difficult to remove except in fragments. This soldering is done as follows: The shields, or metal plates, are coated with a thick layer of tin; these, together with the appropriate pieces of glass, are laid on an iron plate, heated to the melting point of the tin. The piece of hot glass to be soldered is then picked up with forceps and its edge introduced under the surface of the melted stratum of tin and slid forward so as to carry some of the metal before it, thus skimming off the oxidized surface so as to bring clean glass and clean metal in absolute contact. No glue must be used; the least trace of oil or resin will spoil the operation. When the piece of glass is fairly in place it is pressed down in order to squeeze out the surplus solder. It is this sliding action that insures success; if the glass were to be directly pressed down upon the tin solder no adhesion would take place at all from the presence of a trace of oxide and the existence of an air film. The glass, of course, must be polished and perfectly clean.

(11) Beeswax and Venetian turpentine in varying proportions, depending upon consistency desired.

Leather Preservatives.—One hundred parts *Sweet Oil,* 100 parts *Mutton Suet,* 2 parts *Turpentine.* Melt together and apply to the leather, which has been sufficiently warmed so that it will liquefy and absorb the fat. Another formula is as follows: 10 oz. *Linseed Oil,* 10 oz. *Mutton Fat,* 1 oz. *Venice Turpentine* melted together. Apply to the leather when dry and warm and it will preserve it against wet or snow.

WITH THE AMATEURS

Our Amateur Radio Station Contest is open to all readers, whether subscribers or not. The photos are judged for best arrangement and efficiency of the apparatus. To increase the interest of this department we make it a rule not to publish photos of stations unaccompanied by that of the owner. Dark photos preferred to light toned ones. We pay each month $3.00 prize for the best photo. Make your description brief. Address the Editor.

AMATEUR RADIO STATION CONTEST.

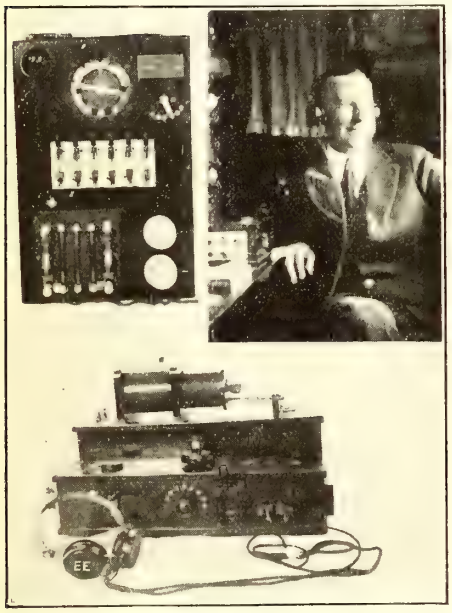
Monthly Prize, $3.00.

This month's prize winner.

THE HOPKINS RADIO STATION.

The accompanying views show the apparatus employed in my successful radio station. The receiving set is of the cabinet style, which consists of a loading coil, loose coupler, primary and secondary variable condensers, crystaloi detector, fixed condenser and a pair of 2,000-ohm 'phones. With this set I am able to hear nearly all the coast stations from (N. A. R.) Key West to (W. C. C.) South Wellfleet.

The transmitting set is of the rotary panel type, which is highly efficient owing to the very short connections. In the base is mounted a ½-K. W. closed core transformer, and above that is the adjustable condenser and rotary spark gap. At the rear of this is the oscillation transformer.



James R. Hopkins and Wireless Set Built by Himself.

The photo shows protective device, condenser and rotary controlling switches mounted on the fiber panel. I am able to communicate with amateurs and ships within a radius of 50 miles and more.

The aerial consists of two copper wires 82 feet long and 35 feet high.

JAMES R. HOPKINS.

Newport News, Va.

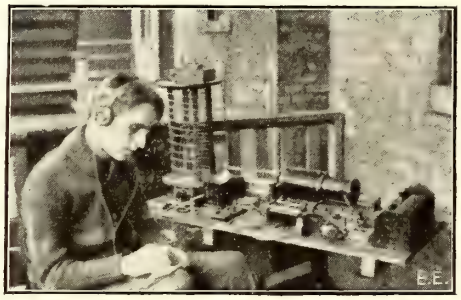
C. JAROSZEWICZ'S WIRELESS OUTFIT.

Herewith are photographs and description of my wireless set for the Amateur Wireless Station contest.

The aerial is 75 feet high and 80 feet long and is composed of six strands of No. 12 hard-drawn copper wire.

The set is all home-made with the exception of the receivers and spark coil.

My receiving set consists of 2,000 ohm Brandes' 'phones, loose coupler, two-slide tuner, loading coil, galena, silicon, ferron, carborundum, and copper-iron pyrites detectors, variable condenser and fixed con-



Fine Experimental Radio Station of Mr. Jaroszewicz.

denser. On favorable nights I can hear N.A.A. 10 feet from the 'phones, while W.G.O. can be heard 50 feet from the 'phones.

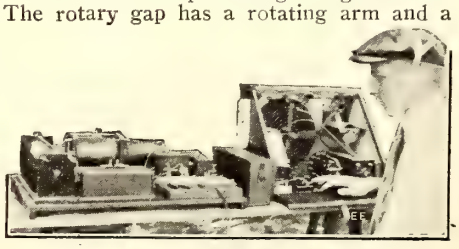
My transmitting set comprises a Mesco type, two-inch spark coil, spark gap, condenser, helix and key. For the source of current for operating the spark coil I use a dynamo which I have constructed with the help of my father. This dynamo while running at a speed of 2,800 r. p. m. generates 50 volts and 30 amperes. The armature of this dynamo is wound with insulated copper ribbon.

Chicago, Ill. CASIMIR JAROSZEWICZ.

UNIQUE RADIO OUTFIT OF FRANK SAHLMANN.

The following is an explanation of my little wireless set, a picture of which is herewith presented.

The set was all made by myself, with the exception of the jump spark coil and the step-down transformer. The key has large platinum points taken from an old spark coil vibrator. The oscillation transformer is made of brass ribbon which has been split and wound on cross arms in the shape observed. The sending condenser was constructed from an old glass tumbler with thin walls, coated inside and outside with tinfoil. The spark gap was made from an old telephone lightning arrester. The rotary gap has a rotating arm and a



Frank Sahlmann's Radio Apparatus.

stationary disk, which renders the gap easier started and stopped and also reduces the vibration. The small rheostat shown is used to regulate the current feeding the coil and is made up of old screen wire.

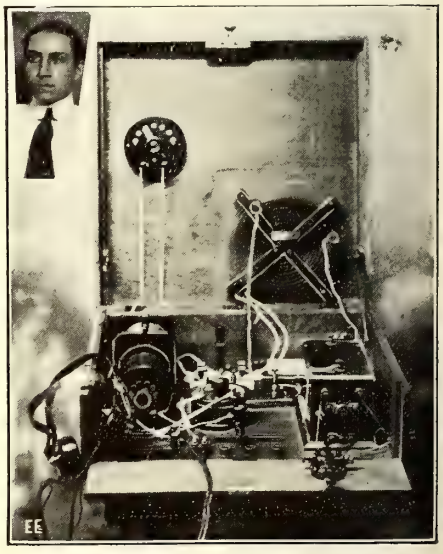
In the receiving set the fixed-adjustable condenser is made up of eight small units, containing from two to 16 sheets of tinfoil each and so connected that from two to 30 sheets may be used at one time. The wire used on the loading coil and the tuning transformer was obtained from the regulating coil of an old arc lamp. The bell and the battery are used for testing purposes. I have made a cover for the receiving set which is not shown. It will be noticed that the set is very compact and thus easily carried from place to place.

Salina, Kan. FRANK SAHLMANN.

D. J. CYR'S WIRELESS STATION.

The accompanying illustration is that of a portable wireless outfit mounted in a specially designed, quarter-sawed oak case made by the owner.

The outfit consists of, from left to right: a loose coupler, a fixed condenser is placed alongside of it; a 23-plate variable con-



Portable Radio Set of Darrel J. Cyr.

denser, a three-cup detector (the bracket being on a rod so as to slide to the different minerals, which are galena, silicon and molybdenite), spark gap, 1-inch spark coil and a moulded sending condenser back of it. The key is on the hinged front and the helix is fastened on the cover. The switch is seen in the rear center. One 1,000-ohm headset is shown in the picture, but will be replaced by 3,000-ohm 'phones. A 5,000-meter loading coil has been placed in the cabinet.

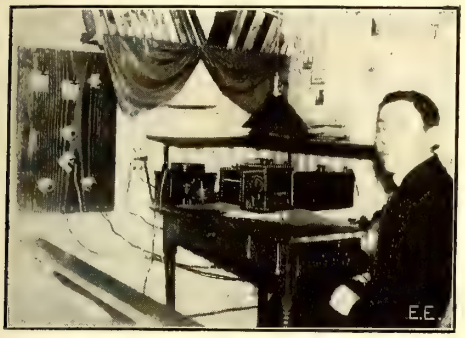
My aerial consists of six wires, spaced 18 inches apart, in the shape of a "V." It is hung on 18-foot poles on top of a house 35 feet high. I can get NAA, WSL and other stations.

I am a member of the Central Radio Association and the National Amateur Wireless Association.

Sioux City, Iowa. DARREL J. CYR.

JOEL YOUNG'S WIRELESS STATION.

My set consists of two receiving outfits—one containing a loose coupler, an audion detector and a mineral detector, one variable condenser, one pair of Murdock receivers of 2,000 ohms resistance; while the other is a new set. This consists of a tuner, one variable condenser and one pair of Murdock 'phones. The outfit is capable of



Joel Young's Radio Station.

receiving Sayville and other undamped wave stations. I have the audion arranged with a double-pole, double-throw switch, so that I may use it on either set. The audion terminals for the tuner go to the main poles of the switch and the secondaries of the other to the other end of the switch. The aerial and ground switches are worked in the same way.

I can hear Arlington on both sets of instruments very loudly. I also hear amateur stations, and commercial ship and coast stations.

My sending set consists of a Blitzen one-quarter kilowatt transformer, a rotary spark gap of my own construction, besides a helix and condenser, both made by myself.

The sending outfit is controlled by a switchboard, which may be seen in the picture.

The sending apparatus is in a small building located about 60 feet from the house. The receiving outfit is in my room. Thus I operate the sending set at a distance of 60 feet, after the fashion of the large commercial stations.

My aerials are as follows: One has four wires, space l 2¾ feet apart, and is 30 feet high and 100 feet long. The other is 500 feet long, 35 feet high and contains but one wire. The material used is galvanized iron wire. The former is used for sending, and both are used for receiving. My official call is 8 ALK. JOEL YOUNG.

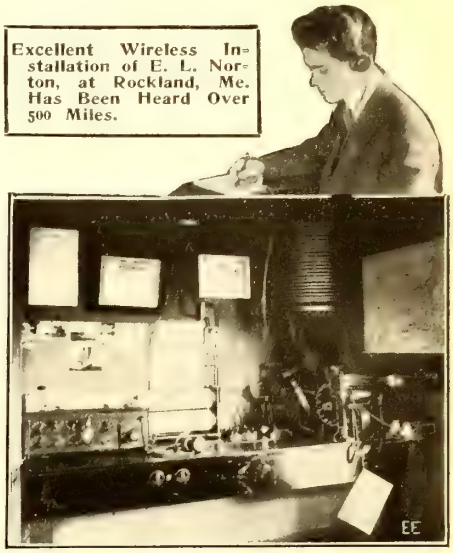
Elmira, N. Y.

RADIO STATION OF E. L. NORTON.

My radio transmitter consists of an .8-K. W. 10,000-volt transformer, rotary gap giving about 900 sparks per second, a condenser of .0085 mfd. capacity, an oscillation transformer and aerial loading inductance. The set is licensed to use all waves up to and including 600 meters. It has a normal night range of about 250 miles, but has been heard at a distance of over 500 miles *over land.*

The receptor is connected on the Armstrong oscillating audion system. With proper primary loading coils it will tune to 12,000 meters. The switches on the front of the cabinet from left to right are: Primary and secondary of large tuner, four switches for controlling the large coils used in the Armstrong system, the audion bulb, the high voltage battery switch, a telephone switch for lighting the audion bulb, changing over to the crystal detector if desired, or for shorting the latter while sending, and at the right a "Blitzen" tuner for short waves.

Excellent Wireless Installation of E. L. Norton, at Rockland, Me. Has Been Heard Over 500 Miles.



Two aerials are used, one for transmitting and for receiving on all short waves, which consists of six copper wires, 60 feet high and 76 feet long, and a single wire 325 feet long for all long waves.

EDWARD L. NORTON.

Rockland, Me.

Amateur News

Institute of Radio Engineers' December Meeting.

The December meeting of the Institute was held Wednesday evening, Dec. 1 in Fayerweather Hall, Columbia University, New York.

Two papers on "Capacities" and "Radio Transmission Phenomena" were presented by Fritz Lowenstein.

The first of these papers dealt with a number of interesting points in connection with the field energy of capacities and endeavored to correct certain common errors in connection therewith.

The second paper considered the phenomena of radiation from normal antennae and contrasted critically the explanation of these phenomena given by Tesla, with those at present in vogue. Highly novel and suggestive explanations of radio transmission were given.

Talo Club of New York City.

The Technical Association of Licensed Operators or Talo Club was formed on Oct. 21, 1913, with the purpose of gaining further knowledge of wireless by combining serious work with theoretical argument.

Meetings are held fortnightly at which papers are presented and discussed. The present membership is: W. Woodrow, president; E. T. Dickey, secretary and treasurer; W. J. Howell, past-president; W. H. Sands, F. L. McLaughlin, R. B. Austrian, S. A. Murray and M. W. Sterns. Address all communications to the secretary's office, 1649 Amsterdam Ave., New York City.

The Yorkville, N. Y., Radio Development Association.

Recently a radio club was organized by several amateurs and scientists who had "fallen" for the "tick-tick." An election was held and Mr. Joseph L. Cermak, was elected president. A very able vice-president was found in the person of Dr. Frank G. Josephs of New York City, also. The club was organized for the purpose of bringing to a higher state of perfection the telephonological radiocommunicative apparatus of the present time, and, according to the latest reports, everything is going along smoothly. Mr. Cermak, who is a hopeless "radio-bug," has contributed largely to the wireless field. An interesting series of wireless lectures were once given by him in Public School No. 158, Manhattan. The members at present consist of his able assistant, Frederick ("Sulphate") Smith, G. Engler, E.E., M.A.; Geo. Barry, Charles Lucek, Frank Bartinek and the honorable scribe, H. Gutman. All communications should be sent to Jos. L. Cermak, E.E., 73 East End Ave., New York, and a good-natured answer will be received by the next mail. Get busy, fellow "bugs."

New California Radio Club, at Redlands.

The amateurs of Redlands, Cal., have recently organized a radio club. The name of the club is "The Radio Club of Redlands." The officers of the club are Ezra Moore, president; Arthur Munzie, vice-president; Rudolph Kubias, secretary-treasurer; Harry Williamson, assistant secretary-treasurer. The other members of the club are Howard Hamilton, Donald Anderson, Ernest Tubbs, Charles Dewith, Norman Peiffer, Dean Fowler and Phillip Murkett. We would be glad to communicate with other radio clubs. Address Rudolph Kubias, No. 457 Alta St., Redlands, Cal.

Radio Club of America October Meeting.

The October meeting of the Radio Club of America was held on Saturday evening, Oct. 9, in Room 304, Fayerweather Hall, Columbia University, New York City.

Mr. Fritz Lowenstein presented a paper on "Quenched Spark Sets." Mr. Lowenstein, who is well-known as a pioneer in this field of apparatus development, described in detail the principles, design and operation of sets of this type, discussing critically many recent developments in the general theory of transmission as applied to quenched spark apparatus.

John L. Hogan, Jr., Emil J. Simon, M. E. Packman and G. J. Eltz were the chief participants in the discussion.

RADIO CLUBS ATTENTION!

We are always pleased to hear from young Edisons and Radio Clubs. Send a write-up of your Club with photos of members and apparatus to-day to: Editor "Amateur Gossip" Section, The Electrical Experimenter, 233 Fulton St., New York City.

East Night High School Radio Society.

On the evening of Oct. 7, the students of the East Night High School of Cincinnati O., interested in the radio art were organized by Mr. Wm. G. Finch and Mr. C. H. Fender, pioneer radio men. The organization was named the East Night High School Radio Society, whose objects are as follows: 1—Advancement and development of the "Radio Art"; 2—To prepare the members to qualify for U. S. Government commercial operator's license; 3—To be able to render effective assistance during times of emergency; 4—To promote radio intercourse among other institutions of learning in the United States.

The following officers were elected: President, Wm. G. Finch; Secretary, C. H. Fender; Treasurer, Professor Frantz.

The society at present has a membership of fifty-two. The society will install a 5 K.W. transmitting set of the most modern type; the receiving set to be the last word in radio engineering. The organization extends an invitation to all other institutions of learning which are in sympathy with their movement to effect a "relay association" among them. Those who are interested in the above movement please communicate with C. H. Fender, secretary, East Night High School Radio Society, Cincinnati, Ohio.

The Junior American Guard.

Boys are wanted to join the Junior American Guard, a juvenile national guard, whose object is to instil into boys the proper regard for discipline, obedience and military instruction.

Among the activities to be carried on are military instruction and engineering, first aid, signaling, wireless telegraphy, marksmanship and drum, fife and bugle instruction.

Since its organization last May, its membership has reached 3,000. At the head of the organization is Brig.-Gen. Andrew C. Zabriskie, a 7th Regiment veteran, and former member of the Governor's staff, and who for many years has been connected with boys' activities.

Second in command is Maj. William H. Elliott, formerly with the Boy Scouts. Headquarters have been established at No. 52 Beaver St., New York City.

Chas. F. White, 117 East 127th St., New York City, wishes to hear from boys between 12 and 18 years of age, especially those interested in wireless telegraphy, for the purpose of organizing a radio and signal corps.

Information will be gladly furnished to anyone over this age who desires to organize in or outside of New York City.

LATEST PATENTS

Focusing Lamp Socket.

(No. 1,153,591; issued to William F. Anklam.)

This lamp socket is intended for

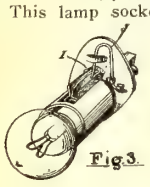
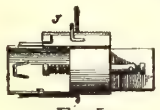

Fig.3.


Fig.4.

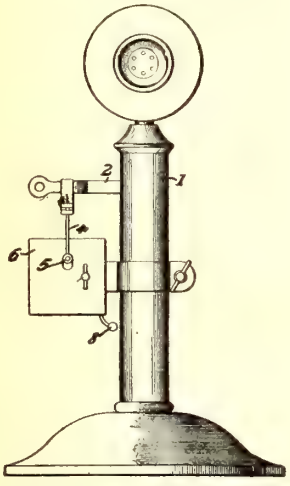

Fig.5.

automobile head lamps where it is desirable and in many cases imperative, that the electric lamp itself shall be properly focused. The socket in this case is held in any required position by means of a flange, rack I and spring wire catch J, engaging same at any desired point to which it may be set.

Telephone Fire Alarm Attachment.

(No. 1,155,722; issued to Felix Gottschalk.)

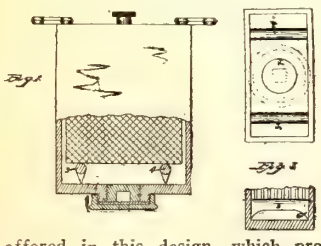
In this telephone fire alarm device, use is made of a fusible link which in case of fire, melts, thus releasing the switch hook 2, and also the trigger 5, of a clockwork actuated mechanism 6, containing a tapper 8. This strikes repeatedly by code signals or otherwise, against the metallic upright column of the telephone stand 1. These tapping sounds are heard at the central office exchange and it is then known exactly from what source the alarm emanates. This device here shown is for telephones other than the common battery type.



Easily Cleaned Storage Cell.

(No. 1,154,372; issued to Augustus P. Burritt.)

An improved storage cell jar is

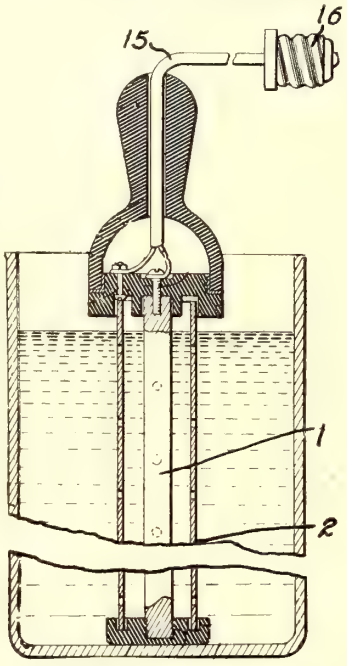


offered in this design, which provides at the bottom of same a large orifice with threaded cap, which may be opened periodically to facilitate the flushing out of the sediment, etc., from the cell. The plates are supported on the arched ribs 3 and 4, thus permitting of the solution or flushing water passing readily through them, without impeding the discharge of the sediment, etc., in this action.

Electric Water-Purifier.

(No. 1,159,699; issued to James A. Murdock, assignor of $\frac{7}{16}$ths to John H. Hirst, and $\frac{9}{32}$ds to Cecile A. Murdock.)

This scheme for purifying water

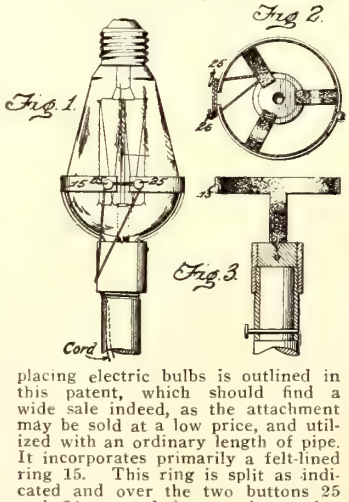


by the action of electrolysis is made possible by passing ordinary lighting current into a cell containing the liquid as shown in the illustration. The electrodes 1 and 2 are connected to opposite sides of the circuit through the medium of a flexible conductor and plug 15 and 16. The tubular electrode 2 is perforated, to enhance the circulation of the liquid.

Electric Globe Replacer.

(No. 1,157,617; issued to Elwood H. Conrad.)

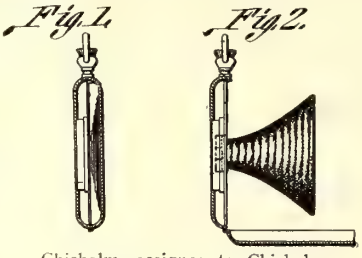
A simple and cheap method of re-



placing electric bulbs is outlined in this patent, which should find a wide sale indeed, as the attachment may be sold at a low price, and utilized with an ordinary length of pipe. It incorporates primarily a felt-lined ring 15. This ring is split as indicated and over the two buttons 25 and 26 a cord is passed, so that when a bulb is placed in a socket, the cord through the re-lamper handle is pulled taut; thereby causing the ring 16 to contract and grip the globe tightly.

Individual Telephone Mouth-Piece.

(No. 1,158,636; issued to Chas. L. Chisholm, assignor to Chisholm Transmitter & Telephone Instruments Company.)

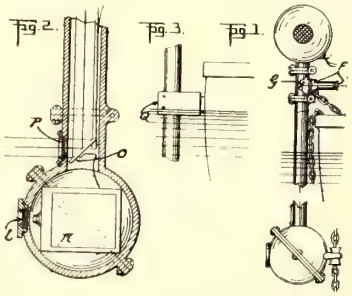


The patentee of this invention claims to provide a satisfactory and convenient form of collapsible and sanitary microphone mouth-piece for telephone systems. Great stress is laid on the unsanitary aspects of the common telephone mouth-piece and he here provides one which may be carried by every individual in the same way as a watch. The mouth-piece is collapsible and comprises a spiral wire form, supporting (when extended) a flexible covering material, such as soft rubber or oiled silk, etc.

Device for Under-Water Exploration.

(No. 1,156,782; issued to Charles Francis Jenkins.)

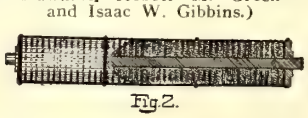
This device comprises a telescopic tube as illustrated, fitted with two chambers, at top and bottom. The

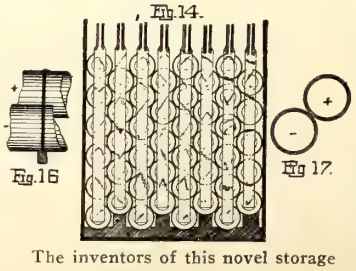


submerged, lower chamber contains a motion picture camera, electrically controlled by means of a wire passing down through the tube from the deck of a vessel or float. A powerful light is enclosed in the upper shell and is projected downward through the tubes, being reflected from a mirror O, through a window P. Pictures are taken by the camera M, through the window L. The submarine landscape may be viewed through a telescope F, by means of a small reflecting mirror G placed in focus of mirror O.

Improved Storage Battery.

(No. 1,159,021; issued to Harry S. Hawkins, Abbott M. Green and Isaac W. Gibbins.)


Fig.2.

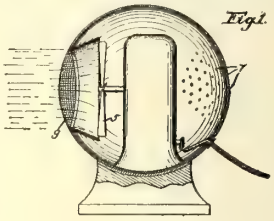


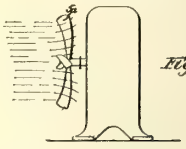
The inventors of this novel storage battery, which seems to possess considerable merit, have designed the positive and negative electrode or plates of a number of cylindrical rods. As may be seen from the illustration each of these rods is made up of alternate discs on a central, lead alloy bar. Every other disc is composed of an active material, which is oxide of lead, and the intermediate discs are made of a porous material, such as volcanic scoria. Around each compound cylinder thus constructed there is placed a foraminous sleeve, of lead alloy for instance, which is also perforated.

Electric Fan Motor.

(No. 1,156,901; issued to Chester I. Hall, assignor to Chicago Electric Meter Co.)

This is another form of electric



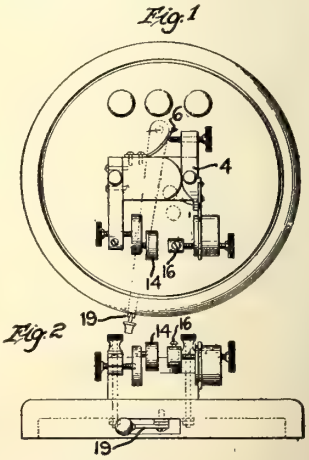


fan motor and is intended to be mounted with motor complete inside of a metal or other shell, as seen in illustration. This shell, at the rear of the fan, is perforated with numerous holes through which the air is drawn and the fan blade projects a draft of air through a screen 9; the mesh of which is not so fine as to impede the propagation of the air. The patentee also claims that by special construction of the blade 5, Fig. 1, and also at 5a, Fig. 2, particularly, that a practically parallel stream of air can be projected or produced.

Radio Detector.

(No. 1,159,969; issued to Charles O. Lorenz.)

This radio detector involves sev-



eral unique features and is to be used with minerals such as Perikon. The support 16 is mounted on a pivoted arm 4, resiliently by virtue of the spring 6. Hence the adjustments of the mineral cup 16 are made independent of the spring tension. The second mineral cup is shown at 14. A short-circuiting switch 19 is provided for protecting the detector while transmitting.

COPIES OF ANY OF THE ABOVE PATENTS SUPPLIED AT 10c. EACH.

Phoney Patents

Under this heading are published electrical or mechanical ideas which our clever inventors, for reasons best known to themselves, have as yet not patented. We furthermore call attention to our celebrated Phoney Patent Offizz for the relief of all suffering daffy inventors in this country as well as for the entire universe.

We are revolutionizing the Patent business and OFFER YOU THREE DOLLARS ($3.00) FOR THE BEST PATENT. If you take your Phoney Patent to Washington, they charge you $20.00 for the initial fee and then you haven't a smell of the Patent yet. After they have allowed the Patent, you must pay another $20.00 as a final fee. That's $40.00 ! ! WE PAY YOU $3.00 and grant you a Phoney Patent in the bargain, so you save $43.00 ! ! When sending in your Phoney Patent application, be sure that it is as daffy as a lovesick bat. The daffier, the better. Simple sketches and a short description will help our staff of Phoney Patent examiners to issue a Phoney Patent on your invention in a jiffy.

PHONEY PATENT OFFIZZ

$$\#\left(\frac{X^2}{4} = 47\right)$$
$$X \overline{(9+F^4)} \times B$$

I. M. STEWED, PUSSYCATNIPSTOWN, HAR.
FELINEOLA

Patent Specifications Filed, Sandpapered and Polished

To Sufferers Throughout the Land:

Let it be known that I, I. M. Stewed, of Pussycatnipstown, in the State of Harmony, have perfected certain necessary and useful improvements on nature. By means of my Cat-Organ or Felineola it is possible to transform a town infected with nerve-racking nocturnal noises into a burg of melody. All this to be accomplished by the proper grouping and controlling of those aforesaid sleep disturbers into a whole harmonious unit capable of rendering orchestral pieces with a purity of note found in none of our so-called modern instruments of the musician's art.

It consists primarily of a series of sound-proof receptacles, the openings of which are controlled by a keyboard. In each and every compartment is placed a cat as per specifications attached. The plan proposed also provides that each family in the neighborhood should dedicate a cat. They are graded according to the pitch of their voices (which does not correspond to their colors) and placed in the proper compartment.

Each box has a sound-proof door hinged at the top with an iron armature, attached so that the magnets on top will open the doors when energized.

The magnets are connected to electrical contacts, which are controlled by a regular player-piano roll driven by a motor.

The effect of this arrangement is the production of harmony that "hath powers to soothe the savage breast," and the screams of the felines will, to such craft as cruise in the neighborhood whose minds are distorted from the fumes of their alcohol burning furnaces, sound like the war cry of His Satanic Majesty, and they will at once deny all further allegiance to King Barleycorn. Thus not only will the citizens' tempers be saved but many erring souls will be saved from a life of degradation.

When the populace tires of this amusement, probably about 1.30 a. m., the Mayor has merely to close the switch and the bottom will drop out of the boxes and allow the cats to fall on the charged wires. They will disperse with one grand finale.

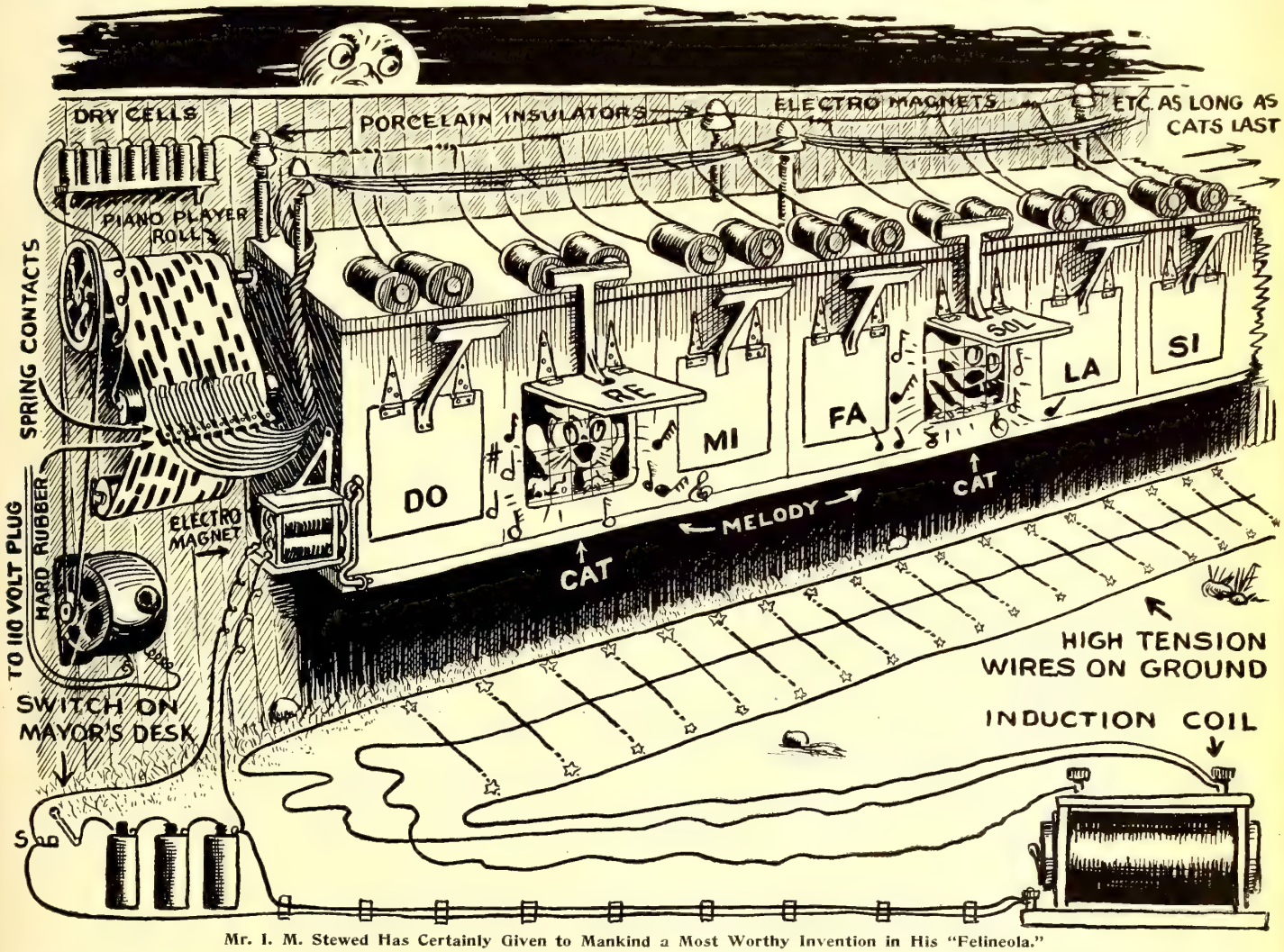
A method is also covered by my invention for recovering the cats for the next entertainment. The cats are, each and every mother's son of them, and daughter, too, fed with mush containing iron filings; after nine feedings they will become highly magnetic. Large electro-magnets mounted on the municipal fire truck will pick up the felines from the highways and low-ways to hold the concert.

This metallic treatment will also give their voices a slight metallic ring that will make their serenade sound not unlike distant church bells on a Sunday morn.

In testimony thereof, I hereunto attach my seal as indication that this idea is approved by the S. P. C. A., for the cats will be no longer picked on or at by sundry bricks, books or alarm clocks.

I. M. STEWED,
Pussycatnipstown, Har.
By his attorney, R. L. Kunan,
Sabula, Iowa.

Witnesses:
WATT A. SIMP,
HOPE U. CHOKE,
TOM KATT.



Mr. I. M. Stewed Has Certainly Given to Mankind a Most Worthy Invention in His "Felineola."

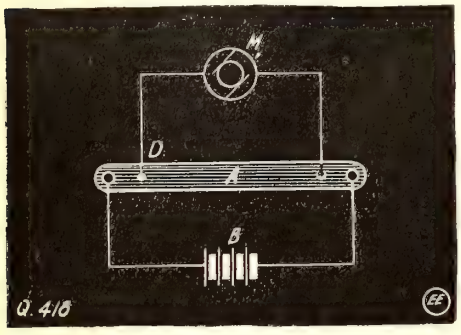
QUESTION BOX

This department is for the sole benefit of the electrical experimenter. Questions will be answered here for the benefit of all, but only matter of sufficient interest will be published. Rules under which questions will be answered:

1. Only three questions can be submitted to be answered.
2. Only one side of sheet to be written on; matter must be typewritten or else written in ink, no penciled matter considered.
3. Sketches, diagrams, etc., must be on separate sheets. Questions addressed to this department cannot be answered by mail.

OHM'S LAW.

(418.) John T. Dwyer, West Philadelphia, Pa., sends us a drawing which is reproduced herewith and wishes to know if current can be drawn from points such as D on the bar A?



Operating Motor in Shunt to Bar Carrying Current.

A. Current may be drawn from the points mentioned, provided the resistance of the bar A between such points as D is equal to or greater than the resistance of the circuit through the motor M. The current flowing through this shunt circuit will depend on the ratio of these resistances.

AMPLIFYING HOOK-UP FOR DETECTORS.

(419.) C. R. White, Brooklyn, N. Y., writes us, asking for a method enabling him to use an audion to amplify from a Perikon detector.

A. We refer you to query No. 410, January, 1916, issue; this hook-up can be used with your instruments.

REGARDING SELENIUM.

(420.) Albert Walker, Erie, Pa., writes us for the address of a concern supplying selenium.

A. This peculiar material is handled by several concerns throughout the United States. The Electro Importing Co., 233 Fulton street, New York City, can supply you with this element in any quantity desired at a nominal price.

CALCULATING AREA OF CONDENSERS.

(421.) David Causey, Greenville, Ill., desires: 1. The formula for calculating the area of tinfoil and glass plates, used in the construction of a condenser for any given capacity. 2. The usual voltage and amperage of three-bar telephone magneto.

A. 1. The formula appended will enable you to calculate the area of the active dielectric necessary for any given capacity:

$$A = \frac{36 \text{ pi } d \times C \times 10^5}{K}.$$

In this formula d is the thickness of the dielectric in cms., C the capacity of the required condenser in M.F. The dielectric constant K can be obtained from any textbook on the subject, and the answer will be the area of the active dielectric in sq. cms. (also pi = 3.1416). The total area may be made up of any number of plates, but for high tension condenser construction the plates are usually 10x12 inches, while in small, low tension condensers the tinfoil strips are usually three inches wide, and the paraffine strips are four inches wide.

A. 2. The regular three-bar telephone magneto delivers about 75 volts and one-quarter ampere, alternating current.

LOADING COILS.

(422.) Grant Merrill, Redwood City, Cal., writes for information on the size of wire used in constructing tuning coils and the best method of making same, whether to wind the coil in a single layer or to wind it in many layers?

A. Loading coils as well as tuning coils can very well be wound with No. 24 to No. 26 magnet wire. The best way of making your loading coil is to wind it on a long cardboard tube in a single layer. Any kind of insulated wire may be used. The wave length is correctly figured by noting the inductance of the coil, which will have to be calculated from some one of the various formulas given in text-books. A simple rule for calculating the wave length of any tuning coil or loading coil is to multiply the length of wire in feet on the coil by 1.5, which will give approximately the wave length in meters.

STORAGE BATTERIES.

(423.) John B. Moore, Buffalo, N. Y., asks us several questions: 1. The current given by two 6-60 storage batteries when connected in series and in multiple? 2. A short method for figuring the wave length of loose couplers? 3. If a suitable form of acid rectifier would work in place of the crystal rectifier employed in wireless telegraphy for detecting the small currents in the receiving set?

A. 1. When two 6-60 storage batteries are connected in series the current obtained will have a voltage of 12 and the batteries will give 6 amperes for 10 hours, but when the storage batteries are connected in multiple the voltage will be 6 or equal to that of one battery, while the current output will be twice as great as from a single battery or 120 A. H.

A. 2. A rough method of calculating the wave length in meters of loose couplers is to multiply the length of the wire in feet on the primary only by 1.5.

A. 3. The ordinary electrolytic detector is nothing more or less than an acid rectifier, for when the current flows in one direction it breaks down the film of hydrogen gas formed on the platinum point and when it starts to flow in the other direction the hydrogen gas is formed around the platinum point, which action is a check on the flow of the current.

INCREASING RECEIVING RANGE.

(424.) Russell Holcomb, Ottumwa, Iowa, writes us asking: 1. When an aerial is located between two hills what is the best method of increasing the receiving efficiency? 2. Are there any commercial or Government stations in Iowa?

A. 1. When an aerial is located between two hills the best method of increasing the receiving range would be to run a long single wire from one hill to the other with a lead-in from the center.

A. 2. There are no commercial or Government stations in Iowa, but several colleges have installed powerful radio transmitting apparatus, particularly the Iowa State College at Ames. This college makes a practise of sending the weather reports to the amateurs located in the State at noon. It is favorably placed for this purpose, being practically in the center of the State.

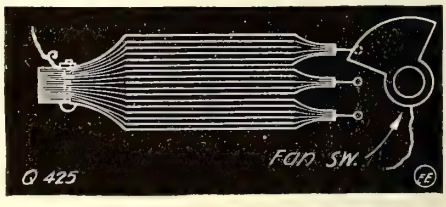
CONDENSER HOOK-UP.

(425.) Kilian Banfelder, Brooklyn, N. Y., desires to know: 1. If the connections for the condenser as shown in his letter are correct? 2. The wave length of a coil 3 inches in diameter and 14 inches long? 3. What high powered station he can receive with his apparatus?

A. 1. The connections shown may be used for controlling a fixed variable condenser, but, contrary to the general rule, the capacity will get smaller instead of larger as more condensers are thrown into circuit. We therefore suggest the use of the hook-up as shown in the accompanying illustration for controlling a number of small fixed condensers.

A. 2. The coil has a wave length of about 900 meters.

A. 3. With your apparatus you should have no trouble in receiving the high powered stations located around New York. You should hear Sayville, Arlington, the Brooklyn Navy Yard and commercial stations within a range of 200 miles.



Utilizing Fan Switch for Connecting Condenser Units.

AERIAL MASTS.

(426.) T. Weston Howard, Dexter, Me., desires to know if the iron masts used for constructing aerials should be insulated from the earth or grounded.

A. Some iron masts for aerial work are insulated from the earth or ground and others are not. The 800-foot mast at Tuckerton, N. J., is a part of the aerial and it rests on massive glass insulators at the base.

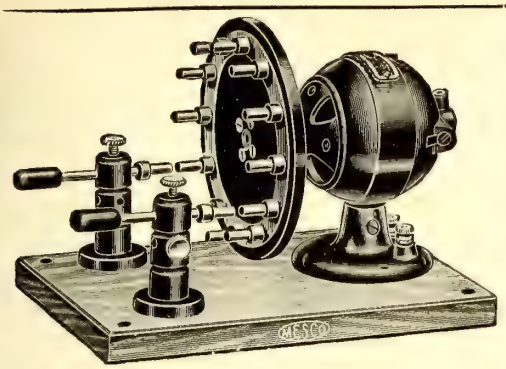
TESLA TRANSFORMER FOR WIRELESS SET.

(427.) A. E. O'Brien, Jr., New York City, wishes to know: 1. Whether a Tesla transformer will improve the sending range of the wireless set. 2. How to receive undamped wave stations with an ordinary receiving set? 3. Why he cannot receive a station using a 1¼-inch spark

(*Continued on page* 578.)

"QUALITY" is our Wireless Watchword

SATISFACTION GUARANTEED OR MONEY REFUNDED OUR MOTTO



Mesco Rotary Spark Gap

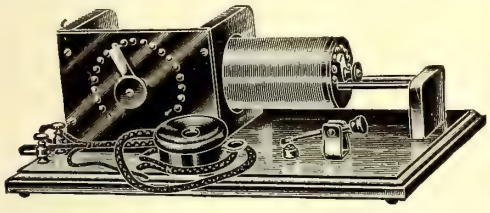
Emits a high musical note. Can be heard at greater distances than the note from the stationary type. Cannot be mistaken for static or other atmospheric disturbances. Produces pure wave of low damping decrement. Increases transmitting efficiency 20 to 30 per cent.

The rotating member has twelve sparking points mounted on a hard rubber disk and is carried on the motor shaft. Can be used on our spark coils or transformers up to 1 K. W. Has two stationary electrodes with special adjusting devices.

Our Globe Motor is used. Will operate on 110 A. C. or D. C. circuits; speed of 4,500 R.P.M. Also made with our Globe Battery Motor, which can be operated on a six-volt circuit.

List No.		Price.
222	**Mesco Rotary Spark Gap**, 6 volt	$12.00
223	**Mesco Rotary Spark Gap**, 110 v., A. C. or D. C.	13.00
216	**Rotary Unit Only**, with two Stationary Electrodes, 1 3/16 in. shaft	5.00

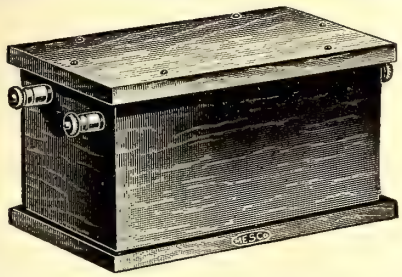
Manhattan Wireless Receiving Set



Consists of a loose coupler, fixed condenser detector, and an 80 ohm receiver with cord. Will tune up to 1,800 meter wave length on a 60-foot aerial. Can be tuned to waves over 4,000 meters with larger aerial and properly connected to loading inductance and variable condenser shunted across the secondary of the receiving transformer.

List No.		Price.
210	**Manhattan Wireless Receiving Set**	$10.00

Mesco Intensifying Transformer

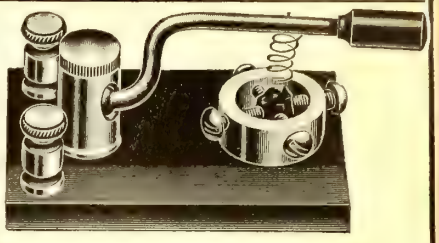


Used for intensifying signals received from any crystal detector by connecting an audion detector on the other side of the transformer winding. Used between two audion detectors, signals will be intensified 10 to 25 times.

As many as three of these transformers can be connected between audion detectors in cascade, forming an intensifier, making it possible to read signals not heard with any single known detector. Diagram of connections with full directions with each instrument.

List No.		Price.
224	**Intensifying Transformer**	$12.00

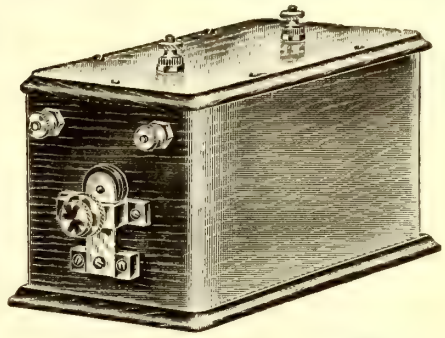
Mesco Universal Detector Stand



Has a heavy brass cup, with four binding screws; will hold crystals up to ¾ in. diameter. A hollow standard encloses a brass ball. Through an opening a brass arm with hard rubber handle is secured fast to the ball, making a ball and socket joint, allowing it to be adjusted at any angle or used in any position.

Hard rubber base 2¼x4¼x⅜ in. All metal parts nickel-plated. Remains permanently in adjustment under jars and vibrations of every description.

List No.		Price.
248	**Mesco Universal Detector Stand**	$3.00



Mesco Wireless Spark Coils

Have low current consumption. Best to operate on dry batteries. Contact points of heavy platinum iridium. Has primary condenser in case. Made for wireless work. Permits of close tuning. Spark at interrupter reduced to a minimum; spark is heavy; made in ¼-inch to 4-inch sizes. Our Manual gives all the technical points.

List No.		Price.
462	**Spark Coil**, 1 inch; can be operated on 6 Red Seal dry batteries	$5.40

Send 10c. for Copy of Our Wireless Manual No. 9

YOU GET YOUR MONEY BACK ON AN ORDER OF $1.00

It contains 120 pages and tells how to erect and maintain wireless telegraph stations. Shows a number of diagrams. Has the Morse and Continental Telegraph Codes. Illustrates the best instruments to use; tells what they are for and how to use them. Has many new diagrams and other valuable information not contained in any other book. Do not wait. Send your request now.

Get the Best 10c. Value You Will Ever Buy

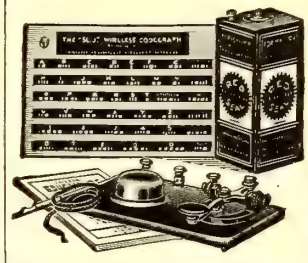
SEND FOR OUR POCKET CATALOG, W 28

It contains 248 pages, 1,100 illustrations and costs you nothing.

IT MEANS MONEY SAVED TO YOU

to have our Manual and our Catalog when you want to buy.

Mesco Codegraph



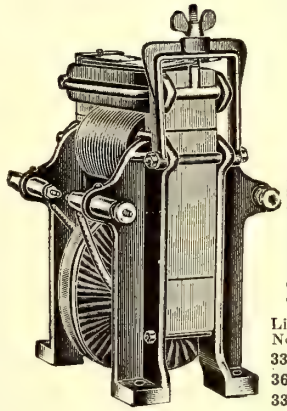
A dandy practice set for the beginner. Just the right kind for the apt boy.

The Codegraph Plate is of metal with insulated dots and dashes. The Pen is connected with the Red Seal Dry Battery and the Wireless Practice Set. When the pen is drawn across the dots and dashes it closes the circuit, and the buzzer sounds. It is possible to attach a sounder to the outfit and get the telegraph click also. A practical and efficient way of learning wireless and telegraph signals.

List No.		Price.
303	**Mesco Codegraph Set**	$2.50
304	**Codegraph Plate, Pen and Book**	1.00

MANHATTAN ELECTRICAL SUPPLY CO.

New York, 17 Park Place. Chicago, 114 S. 5th Ave. St. Louis, 1106 Pine St.
San Francisco Office, 604 Mission St.



Mesco Flexible WIRELESS TRANSFORMERS

Will make wireless apparatus 200 per cent. more efficient. When short circuited or when charging condensers does not consume any more power than the magnetic shunt is set for. Can be connected direct to alternating circuit.

List No.	Capacity.	Secondary Voltage.	Pr.
330	½ kw.	5,000 v.	$15
363	¾ kw.	10,000 v.	20
331	1 kw.	20,000 v.	25

Mesco Wireless Receivers

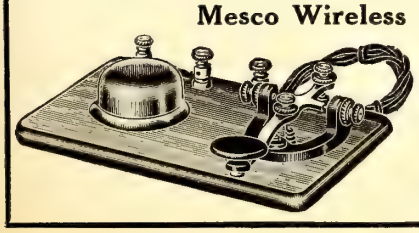


Have powerful field magnets and thin diaphragms, and are very sensitive. Our No. 480 Double Head sets complete have been used in receiving commercial wireless messages over distances of 2,000 miles. All receivers are wound with silk covered copper wire.

Best steel obtainable used in construction of the permanent magnets. Users have had head sets for five years and over without any deterioration in sensitiveness. This cannot be said of any light-weight receivers.

List No.		Price.
480	**Double Head Band**, with six-foot green silk cord and two receivers, 1000 ohms each	$6.00

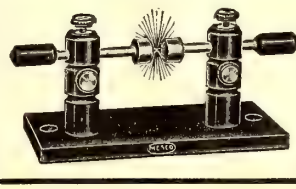
Mesco Wireless Practice Set



Comprises a regular telegraph key, without circuit breaker, a special high pitch buzzer, one cell Red Seal dry battery, and four feet of green silk-covered flexible cord. The main object of the set is to enable the beginner to master the wireless code, and the buzzer reproduces the sound of the signals of the most modern wireless stations perfectly.

List No.		Price.
342	**Wireless Practice Set**, with battery and cord	$1.50

Mesco High Efficiency Spark Gap



Adapted for stations up to ¼ K.W. capacity. Base is of polished hard rubber. Standards are of hard rubber composition of the highest insulating properties. Hard rubber ends on the brass rods permit the length of the gap to be varied, while sending. Spark terminals are of zinc, and are renewable.

List No.		Price.
465	**High Efficiency Spark Gap**	$3.00

YOUR RANGE
DEPENDS ON YOUR
RECEIVERS



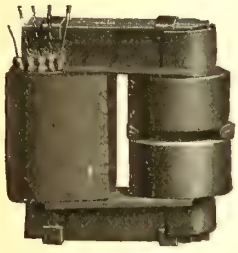


Holtzer-Cabot
Radio Receivers
have honestly earned their reputation of being the

"Most Sensitive Receivers Made"

Other features are light weight, comfortable shape, durability, perfect finish. Send for Booklet 20 D2 for description.

THE HOLTZER-CABOT ELECTRIC CO.
BOSTON — CHICAGO



UNMOUNTED TRANSFORMER

You Can Get Results with a small condenser and this transformer

It is a 1-2 K. W. size and is built on the same specifications as to material and workmanship, etc., as our big central station transformers.

Hundreds of stations are now using these transformers. This transformer gives you 13,200 volts.

Let us tell you how you can do part of he work yourself and get this transformer at a remarkably low cost.

THE PACKARD ELECTRIC CO.
555 Dana Avenue Warren, Ohio

100 PERSONAL OR PROFESSIONAL CARDS
Leather Card Case FREE with each each order. Write for samples and Type List.
ELITE CARD PRINT CO.
Station M Jackson, Mich.
50c

QUESTION BOX.

(*Continued from page 576.*)

coil located 6 miles away when he can get Arlington during the day?

A. 1. The Tesla transformer of the regular type will be of practically no use in a wireless station and an oscillation transformer is not advised except with powers of ¼ K. W. or more.

A. 2. You may receive undamped wave stations with an ordinary wireless set by connecting the tikker in series with the secondary circuit. The tikker can be built according to instructions that have appeared from time to time in this journal.

A. 3. The 1½-inch spark coil set which will not send signals 6 miles is, no doubt, poorly tuned for the best results. It is necessary to tune the set carefully and to get the closed and open oscillating circuits in resonance before the maximum range can be covered.

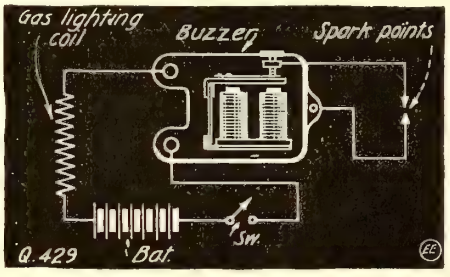
DYNAMO PLANT.

(428.) Oscar Stulman, Baltimore, Md., wishes to know if it is practical to drive a 24-watt dynamo with an ordinary sewing machine by connecting the pulley and treadle of same with the dynamo by means of a belt?

A. The small dynamo can be attached to a plain sewing machine by the regular belt and you can drive it up to full power by means of the treadle. It will light from 8 to 10 6-volt Tungsten lights, depending on the candlepower of same, which should not be over 1 candlepower each. With this arrangement you can also charge storage batteries, although the process is very slow.

JUMP SPARK FROM BUZZER.

(429.) Sigmund Senz, Bronx, N. Y., wishes to know: 1. How to obtain a jump



Jump Spark Produced from Buzzer.

spark from a buzzer? 2. If an ordinary alternating current magneto may be used for ringing an electric doorbell?

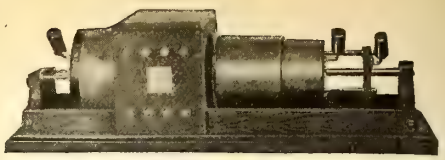
A. 1. You can obtain a minute jump spark from a buzzer by using the connections shown herewith. For best results it is necessary to use quite a number of batteries on the buzzer and to have a rather long throw on the armature. The spark will not be more than 1-16 inch at the most, and this method is a very poor manner for obtaining a jump spark.

A. 2. You may ring a polarized bell with an alternating current magneto very easily, but we doubt if this machine will deliver enough current to ring an ordinary electro-magnetic bell.

GAS FOR BALLOONS.

(430.) Claude Martin, Brownwood, Tex., wishes to know what chemicals will generate a powerful lifting gas that would be safe and non-explosive and the type of generator required.

A. The gases used for inflating balloons is hydrogen gas or illuminating gas. The former is obtained by dissolving scrap zinc in a 4 to 1 solution of sulphuric acid, and the latter is purchased from a local gas plant. We know of no gas with any power-



Type AML—Patent Pending

The Precision Varicoupler

is perfection in receiving tuners. It gives you absolute precision in tuning. It has

No Taps	No Sliders
No Switches	No Delicate Parts
No "Dead Ends"	All the Wire in
No Contacts	Use all the Time

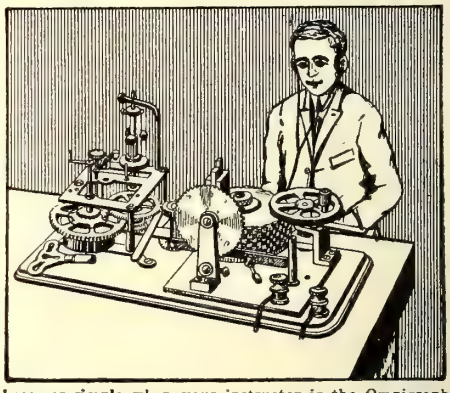
and is of up-to-date design.

Type AML - Price, $25.00
Type AMS - Price, $17.50

For detailed information write for circular P1

The Precision Radio Equipment Co., Inc.
General Office: 868 Putnam Ave., Brooklyn, N. Y.

LEARNING TELEGRAPHY



becomes simple when your instructor is the Omnigraph Automatic Transmitter. Combined with a standard key and sounder or Wireless Buzzer, it will send you telegraph messages at a slow speed, which can be increased at will to match the sending of an expert operator as you become more proficient. Adopted by U. S. Gov't. Made in 4 styles, from $2.50 up, all accurate. Circular free.

Omnigraph Mfg. Co., 39 L Cortlandt St., New York

$8.50 Guaranteed Amplifier Coils $8.50
TRANSFORMERS
Built for Wireless
The Pittsburgh Wireless Equipment Co.
are under new management at
RIDGWAY, PENNSYLVANIA
and are on DECK to give you a SQUARE DEAL and 100% value in our
Superior Radio Apparatus
for every dollar's worth purchased
Send 10c. for our complete catalog.
Parts catalog free.
PITTSBURGH WIRELESS EQUIPMENT CO.
RIDGWAY, PENNSYLVANIA

ful lifting properties that is not explosive and they are all more or less dangerous.

60 CYCLE TRANSFORMER ON 25 CYCLE CURRENT.

(431.) Clayton B. Shelley, Barker, N. Y., wishes to know: 1. If it is possible to operate a 60-cycle transformer on a 25-cycle circuit? 2. Why it is that when N. A. A. is sending on low wave lengths the signals die out, but when he moves the secondary of the coupler in and then draws it out to its original position the signals become strong again?

A. 1. A 60-cycle transformer may be operated on a 25-cycle circuit by using a resistance or a choke coil in series with it. The output of the apparatus will not be up to the full rating of the transformer.

A. 2. It appears to us that the rods on which the secondary slides are corroded and the spring makes poor contact with them. When the secondary is slid along the rod it has the effect of scraping the rod clean and the contact is much improved. This may account for the signals coming in strong again.

SAL-AMMONIAC CELLS.

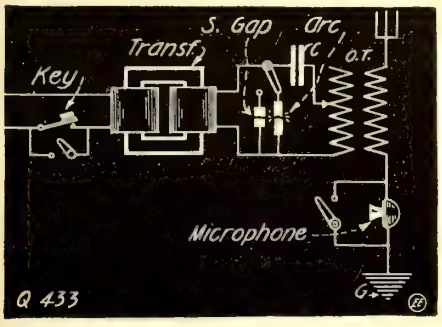
(432.) D. W. Fleming, Ottawa, Kan., asks: 1. If the carbon in the sal-ammoniac cells requires renewing from time to time? 2. If such cells may be used for lighting small lamps?

A. 1. The carbon in the sal-ammoniac cells does not need renewing, but it may occasionally be necessary to put the carbon in boiling water to drive out the salts that settle in the pores.

A. 2. These batteries may be used for lighting small lamps for 2 or 3 minutes at a time, but their amperage soon drops off, due to the polarizing of the carbon.

WIRELESS TELEPHONE SET.

(433.) J. B. Starkweather, Newtonville, Mass., desires to use a ¼-K. W. Clapp Eastham transformer in a wireless set and



Using A. C. Radio Transformer for Telegraphic or Telephonic Transmission.

in a combination wireless telephone and telegraph set, the supply current being alternating current.

A. We append a diagram of connections which will enable you to use the apparatus as either a wireless telephone or telegraph. As will be seen, a spark gap and arc may be thrown across the secondary terminals of the transformer as desired. The arc used may be of the regular carbon type or one utilizing carbon and copper rods and built according to the usual practice in wireless telephony. Although the 60-cycle alternating current supply will cause more or less of a hiss the outfit will work satisfactorily for distances of 5 miles. It is preferable to use an oscillation transformer, and the microphone transmitter is connected in the ground lead, while the key, which may be short-circuited by a switch when the outfit to be used as a wireless telephone, normally operates the set.

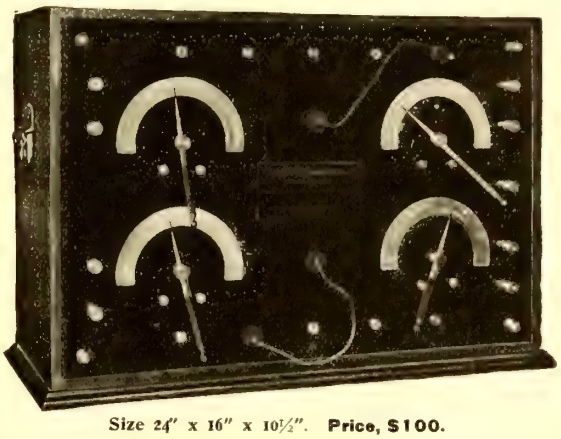
Multi-Audi-Fone

The new wonder in the wireless world. It increases the Audibility 1,500 Times

We Guarantee Everything We Make! We Guarantee Everything We Say!

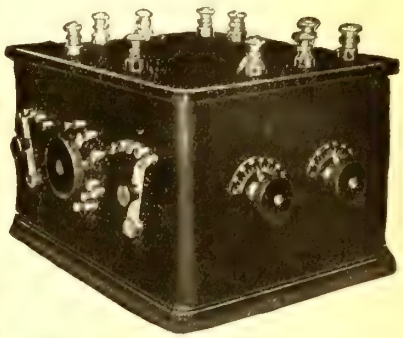
Everything We Make Is the Standard

UN-DAMPED-WAVER
(Will get Nauen, Hanover, Arlington, Sayville, Honolulu.)



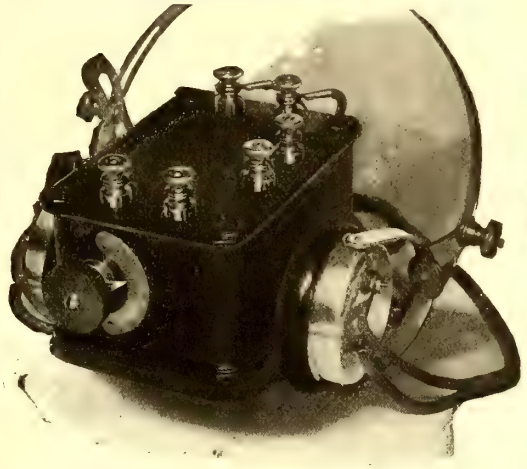
Size 24" x 16" x 10½". **Price, $100.**

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With our specially wound Head Set and specially designed Horn.
Size 8½" x 6½" x 5½". **Price, $75.**

MULTI-AUDI-FONE



With our specially wound Head Set.
Size 4¼" x 3" x 2½". **Price, $30.**

TELEPHONE VOICE MULTIPLIER



(Will increase voice 40 times.)
Size 4¼" x 3" x 2½". **Price, $15.**

Every one of these instruments is *one hundred fold better than any other instrument of its kind.*

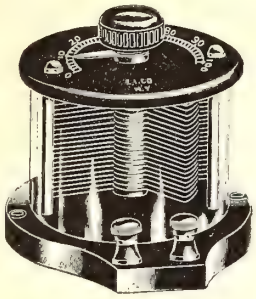
If you don't believe it—try them.

If after a ten days' trial you are not surprised and more than satisfied—we will return your money.

Will any one else do this? **Tear this out and ask for information about the instrument that interests you by writing its name here_____**

Send for circular to-day
Ask your dealer to-morrow
MULTI-AUDI-FONE
273 Morris Ave.
ELIZABETH, N. J.

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No. 9240—17 Plate Rotary Variable Condenser, $2.25
No. 9241—43 " " " " 3.75



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6 inches long, complete .....**65c.**
Extra battery....**20c.** Extra bulb....**15c.**

60 and 100 Watt Nitrogen Lamps use less current; give white light.
60 Watt.....**85c.** 100 Watt.....**90c.**



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Extra bulb, **15c.** Extra battery, **20c.**

FINE **50c.** POCKET CIGAR LIGHTER. Turn the wheel. Flint good for 5,000 lights. (2 for **25c.**), or each **15c.** New Flints, **5c.** 6 for **25c.**

We carry a very complete line of Wireless Apparatus in stock, being Chicago headquarters for the Electro Importing Co. Same prices, same goods and Free Wireless Course. Lionel Trains, Motors, Transformers, Wireless Outfits, Structo Metal Building Material, Automobile and Electrical Supplies. Send 4c. in stamps for complete catalogs.

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NEW WIRELESS WONDER

THE INSTANT RADIOGRAPH

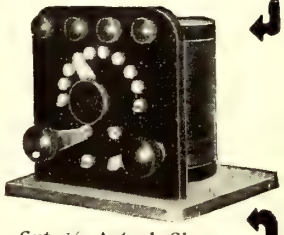
Greatest invention of the Age. The result of years of experimentation.

Abolishes detector troubles and adjustments—
No more delays—no more lost time and messages
Pick up your receivers any time, Summer or Winter, in any atmospheric conditions and—

You Can Receive Instantly Without Any Adjusting

3,000 miles is latest record of the Instant Radiograph.
It is wonderful, but true, you cannot get the Instant Radiograph out of adjustment no matter how you knock it about. Try it yourself, hit it with a hammer while in use.
Vibrations, jars, knocks cannot affect it as there are no fine adjustments to make—no batteries—nothing to wear out—no operating expense whatever.

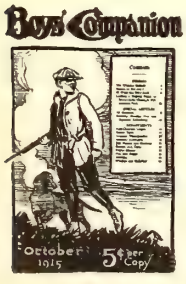
INTRODUCTORY PRICE FOR FEBRUARY **$3.00**



Cut ¼ Actual Size.

The Instant Radiograph is more efficient than any detector on the market, as there is nothing to adjust.
The Instant Radiograph is beautifully and solidly constructed on a heavy base of hard rubber 4 x 4 inches square with rounded corners and high; binding posts are made of non-corroding metal, heavily silver plated, and have heavy rubber-covered thumb screws, preventing current leakage. **All contacts are large, non-corroding, heavily silver plated, of large size and will last a lifetime. This is a wonderful instrument of distinctive appearance that you will be pro ud to have in your wireless station.**
The Radiograph is the greatest recent invention in the Wireless field. Its value is priceless and as we want every professional and amateur operator on land and on board ships to use it, we have decided to make an introductory price of $3.00 for a limited time only. This is only one-third of the price at which it should be sold. Send your order at once. **Send for free Catalog E of the Instant Radiograph.**
Free—Instant Radiograph—a book you need. "Radio Stations of the World." A complete authentic list of call signals of every public wireless station. Price, only 50c.

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BOYS' COMPANION, 1122 The Temple, CHICAGO, ILL.

BICYCLE HEADLIGHT.

(434.) W. L. Rodrigues, Charleston, S. C., asks for data on the method of attaching a dynamo to his bicycle to enable him to light a small headlight for same.

A. A dynamo that would be suitable for use on a bicycle would be a 24-watt machine. This should be bolted to the bicycle frame under the seat and a friction pulley on the shaft should make contact with the rear wheel. This machine delivers 6 volts at full speed. And when traveling 5 or 6 miles an hour this voltage will be delivered. Four small dry cells should be connected across the wires to keep the light lit when traveling below this speed. A tungsten lamp should be used so that it would not be burned out when the voltage rises above normal. You can use a clamp for connecting this to the frame and no trouble should be encountered.

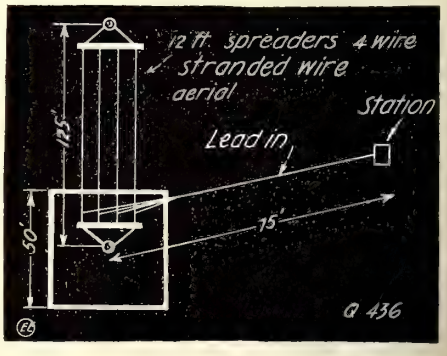
K. V. A.

(435.) Noble A. Allen, Beacon Falls, Conn., writes us asking for the explanation of the term "K. V. A." when applied to high tension alternating currents. As an example he wishes us to figure the horsepower of a transformer stepping 11,000 volts down to 440 volts, which is rated at 100 K. V. A.

A. The expression K. V. A. extended means kilo-volt-ampere. Since the volts times the amperes equal the watts, the expression really means kilo-watts. However, in alternating current work it has been found that the actual voltage and amperage in the circuit and registered on the ammeter and voltmeter and that registered by the wattmeter do not correspond. This difference is known as the "power factor." When the power factor is one or unity, the kilo-volt-amperes refers to kilowatts. However, when the power factor is other than one the expression "K. V. A." is used to indicate that the volts and amperes as actually flowing in the circuit are meant and the wattmeter reading is to be disregarded. Therefore 100 K. V. A. with a power factor of 1 or unity is equal to 138 horsepower. This figure is obtained by dividing the 100 K. V. A., or kilo-watts, by .746 K. W., which is the equivalent of 1 horsepower.

EFFICIENT AERIAL.

(436.) L. L. Baker, Tulare, Cal., sends us a problem on aerial construction. He has



Special Antenna Layout.

a mast 95 feet high in the center of an area 50 feet square. The station is to be located 75 feet east of the mast, and he has means of fastening an aerial 60 feet high 125 feet north of the plot of ground. He desires to know which would be the most efficient aerial under these conditions.

A. We show herewith the plan of an aerial that will be most efficient under the

conditions mentioned in the question, and it will have a natural wave length of approximately 350 meters.

BUZZER TRANSMITTING.

(437.) Charles Welsh, Philadelphia, Pa., sends us a drawing of a buzzer set and wishes to know: 1. If it is practical? 2. How to connect a tuning coil and loose coupler? 3. What could be added to increase the sending radius of a buzzer set.

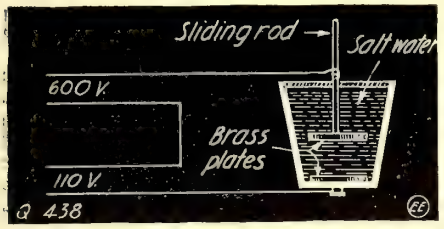
A. 1. The hook-up you show of the buzzer transmitting outfit is impractical for several reasons. The principal reason is that the buzzer A will not operate, due to the fact that the vibrator on this buzzer is not connected in the return circuit to the battery.

A. 2. A tuning coil is generally used as a loading coil in connection with a loose coupler. This is accomplished by connecting the instrument in series with the aerial lead.

A. 3. To increase the sending radius of a buzzer outfit the addition of a kick coil in the circuit will have the effect of increasing the range. This coil will cause larger sparks at vibrator points, which will in turn energize the aerial in a more powerful manner.

CURRENT REDUCER.

(438.) Geo. Outen, Oberlin, O., asks: 1. How to reduce 600 volts direct current to



Use of Water Rheostat in Reducing Voltage.

110 volts? 2. The wiring diagram of a receiving set using two audions. 3. Is it necessary to use an interrupter on a 1-K. W. open core transformer operated from 110 volts direct current?

A. 1. The cheapest method of reducing 600 volts direct current to 110 volts is by the use of a water rheostat or some form of wire resistance. The rheostat may be made according to illustration herewith, or if a wire resistance is preferred you may use 2 pounds of No. 20 German silver wire wound on some sort of a form. Either of these arrangements will pass 5 amperes.

A. 2. For hook-up on a set using two audions we refer you to page 489 of the January, 1915, issue of this magazine.

A. 3. The usual practice when a 1-K. W. transformer is to be operated on a 110-volt direct current supply is to utilize a rotary converter. The rotary consists of a machine that takes direct current on one side and delivers alternating current on the other. This is the best method of operating a transformer, as an interrupter for handling 10 amperes at 110 volts would be very noisy and expensive.

ELECTROLYTIC INTERRUPTER.

(439.) Milford M. Henderson, Salt Lake City, Utah, desires to know: 1. The constituents of the electrolyte in an electrolytic interrupter. 2. What range can be covered with an aerial 35 feet long and 25 feet high, using a buzzer and condenser and standard hook-up for such an arrangement. 3. A wiring diagram for three ½-inch spark coils and one make and break coil with an electrolytic interrupter.

A. 1. The solution used in electrolytic

Everyone is talking about the Electroset Co's

ARLINGTON TESTED MINERALS

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Why Buy Minerals on a Gamble?

The least expensive and the *most important* part of your wireless equipment is the mineral in your detector.

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Read What Others Say!

A few letters selected at random from our files.

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The Arlington Tested Galena Crystal that I bought of you some time ago has given the best service, by far, of any crystal I have yet used.

Yours very truly,
RALPH H. SAYLES, Jr.

N. Manchester, Ind.

I received your N A A Tested Galena. It is more satisfactory than advertised.

Yours truly,
EUGENE SMITH.

Purcell, Okla.

I received the N A A Minerals last week, and I want to tell you that better results have been obtained with them than with any other. Yours truly,
JACK GILLETTE.

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They have to be. Our buyers scour the world for these supremely good minerals—but remember, after all, that even Electro-Set Minerals are not too high priced for the smallest pocketbooks.

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N A A Galena, each crystal carefully tested by experts for distant stations. Individually wrapped and packed in tin containers. Postage paid..... 25c.

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Triple "A" Grade Electro-Set Minerals

Packed in convenient one, four and sixteen ounce cans

These ultra-sensitive minerals are the only ones you should buy. Look for the original signature on the wrapper.

PRICE LIST OF TRIPLE "A" GRADE MINERALS

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Galena	25c.	60c.	$1.50
Silicon	25c.	75c.	2.50
Bornite	25c.	75c.	2.50
Copper Pyrites	25c.	60c.	1.50
Iron Pyrites	25c.	50c.	1.50
Molybdenite	25c.	70c.	2.00
Carborundum	25c.	60c.	1.50

Zincite, Pine, per ¼ oz. Can, 50c.

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Electro-Set Mineral Outfits 50c.

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Five different minerals are packed in individual containers and are sent prepaid anywhere.

Triple "A" Minerals are Furnished. Galena, Silicon, Molybdenite, Bornite, Carborundum. Complete set **50c.**

FREE
With each outfit one piece phosphor bronze cat whisker wire.

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1 set of 5 different minerals in individual tin containers.
2 nickeled binding posts.
1 support post.
1 detector cup.
1 brass rod, threaded.
1 insulator knob
1 polished wood base.
1 ft. phosphor bronze wire,
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Experiment with different types of detectors. A mighty interesting and reasonably priced outfit, complete as described..... $1.25 prepaid.

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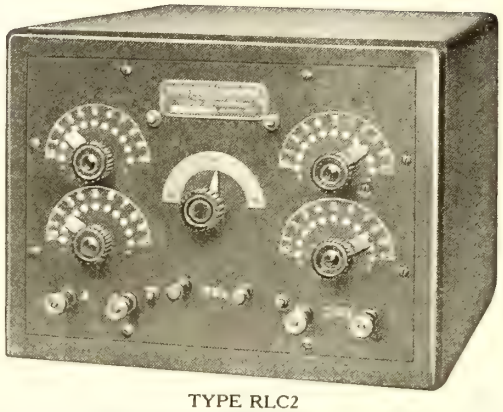
"Mignon System"

Apparatus of Scientific Construction for the Reduction of Static Interference

High Resonance—Unapproached Selectivity

NO TICKERS NOR ARMSTRONG CIRCUITS REQUIRED for the reception of CONTINUOUS wave signals if you own a

MIGNON-SYSTEM CABINET



TYPE RLC2

De Forest Audion Detectors and Amplifiers

BRANDES RECEIVERS

Crystaloi Detectors, Etc.

Write for R6 Catalog, Dept. "B"

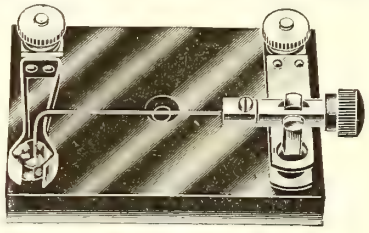
MIGNON WIRELESS CORPORATION

ELMIRA, N. Y., U. S. A.

2 NEW BUNNELL WIRELESS SPECIALTIES

The Jove Crystal-Detector-Holder is the simplest, handiest and most perfect arrangement yet produced. It holds crystals without using clamp screws.

It firmly holds crystals of different minerals at the same time—change of contact from one to the other can be instantly made; a sensitive point quickly found, and the correct pressure held constantly, all without using a single screw or nut. It is designed and finished in our well-known high grade style. Mounted on dark enameled porcelain base with metal parts nickel-plated and highly polished. Postage weight, 1 lb.
Price, Net $1.00



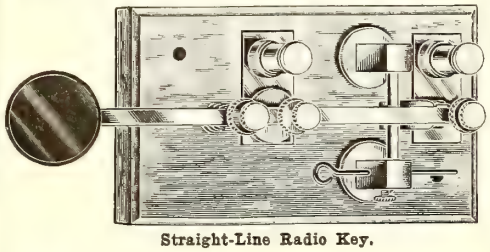
Jove Crystal-Detector-Holder.

The Straight-Line Renewable-Contact Radio Key is much superior to other types of Radio Keys.

Not only are the contacts renewable; but, no matter how much worn, full contact surface can be maintained between them, and the lever retains its normal horizontal position.

This is accomplished by mounting the upper contact on an adjusting screw, which is threaded through the lever and held in position by a check nut. The lower contact is so arranged that it may be loosened for adjusting.

By holding the lever down, with lower contact loose, and then clamping it, perfect surface alignment between the faces of contact pieces is secured, and thus fading or irregularity in strength of signals caused by varying resistance of contact points is eliminated and the contact pieces may be practically used up before renewal becomes necessary.



Straight-Line Radio Key.

Another desirable feature of our Straight-Line Radio Keys is the self-clamping binding posts with which they are equipped. These posts make loose connections impossible.

The Keys are mounted on heavy, polished marble bases (6 in. x 3½ in. x 1 in.). The metal parts are heavily nickel-plated and polished, making a strikingly handsome symmetrical instrument.
Price, with ⅜ in. hard silver contacts; postage weight, 4 lbs..... net, $7.50

Send for descriptive circular and copy of our Wireless Catalog.

THE J. H. BUNNELL CO., Inc., Electrical Manufacturers, "Dept. EX", 32 Park Place, New York City

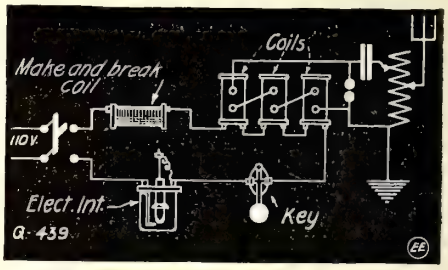
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interrupters consists of a mixture of 1 part sulphuric acid and 5 parts water, or a 16⅔ per cent. solution.

A. 2. With an aerial of the size mentioned and the buzzer transmitting outfit you may cover 1 mile under very favorable conditions. The hook-up suitable such an outfit was given on page 352 of the November, 1915, issue of this magazine.

A. 3. We give herewith a diagram of connections for wiring three ½-inch spark coils. The make and break coil should be connected in circuit as shown to control the input to the interrupter. We do not



Operating Three Spark Coils with Electrolytic Interrupter.

advise the use of such small coils with an electrolytic interrupter, as the unduly high voltage of the secondary has a tendency to puncture them when used for a short time.

POULSEN TIKKER.

(440.) LeRoy D. Brown, Winkelman, Ariz., wishes to know: 1. What instruments are required to receive messages from a station using a Poulsen Arc? 2. How to protect his instruments from being destroyed by a near-by high power radio station? 3. The construction of a ¼-K. W. transformer?

A. 1. To receive messages from a Poulsen station you will require some form of a tikker or oscillating audion. The former consists of a special form of circuit breaker and can easily be made by mounting a small brass disc on the shaft of a toy motor and then filing a groove around the edge of the disc with a triangular file. A fine spring brass wire is laid in this groove and connections are made to the motor frame and the fine wire. The apparatus is connected in series with the 'phones and has the effect of breaking up the high frequency oscillations so that they become audible in the head set.

A. 2. To protect the instruments from near-by high power stations the usual practice is to connect a micrometer gap across the primary leads of the loose coupler. A Geissler tube may be used for the same purpose, the extra strong signals being conducted direct to the ground.

A. 3. A ¼-K. W. transformer may be constructed on a square iron core having a cross section 8 inches square and outside dimensions of 6¾x5⅜ inches. The secondary core is insulated with a layer of mica and two layers of Empire paper. The secondary consists of 2 pounds of No. 34 enameled copper wire, or 16,000 turns. The primary is constructed from 3½ pounds of No. 16 D. C. C. wire, which will be enough for 485 turns. The input on this transformer will be 3½ amperes at 110 volts.

FILMS FOR CONDENSER.

(441.) Theo. C. Braun, Jersey City, N. J., wishes to know if film negatives can be used as the dielectric in a condenser for receiving purposes.

A. The material used in making films is ideal for constructing small receiving condensers, but it is necessary to remove the emulsion from same. The sensitive mix-

ture used on films contains silver nitrate, which is a conductor, and it would have to be removed by soaking in water and carefully scraping the film.

TRACTIVE MAGNETS VS. SOLENOIDS.

(442.) James Dowdall, Brooklyn, N. Y., desires information on: 1. Which is the best type of magnet to draw up a weight of 1 pound a distance of 2½ inches from the pole pieces? 2. Where to purchase platinum wire as used in gas stove igniters and its price? 3. Whether dry cells will perform their work if exposed to freezing temperature?

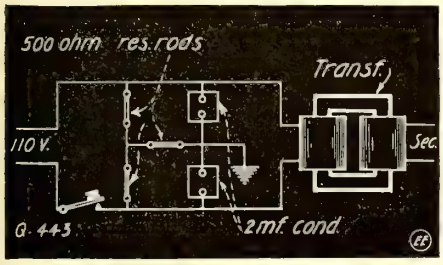
A. 1. When a weight is to be moved 2½ inches it is the usual practice to utilize a solenoid for this purpose. A solenoid having a magnetic pull of 2½ inches requires much less current and is much smaller than any magnet that will do this work.

A. 2. The platinum wire used in gas stove igniters is of very small size, and we do not know if same can be purchased separately. However, you may take up the matter with dealers in experimental apparatus who may be able to quote you on this fine wire. Refer to our advertising columns.

A. 3. A dry cell will perform its work perfectly when subjected to the temperature of freezing water, but when the cells are cooled to such a point where the small amount of moisture in them is solidified the resistance will be increased and the output lessened.

KICK-BACK PREVENTER.

(443.) Raymond Guy, Tottenville, N. Y., asks us for information on: 1. The construction of a kick-back preventer. 2. The wave length of an aerial 55 feet long and 40 feet high. 3. The receiving transformer sold by the Colby Telegraph School, Auburn, N. Y.



Hook-up of Radio Transmitter with Protective Condensers and Resistance Rods.

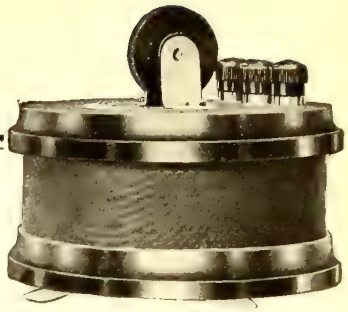
A. 1. A kick-back preventer can be made from 2 one micro-farad telephone condensers which are connected in series across the primary of the transformer and the center connection grounded, as shown in the accompanying illustration. Three resistance rods of 500 ohms' resistance may also be used for the same purpose, as shown.

A. 2. The wave length of the aerial is approximately 165 meters.

A. 3. The receiving transformer sold by the Colby Telegraph School consists of two secondary coils with a slider on each. Inside these coils the primary slides back and forth. By adjusting the position of the primary and the inductance of the respective secondary coils good selectivity is obtained and the signals come in loud.

AUDION QUERIES.

(444.) N. G. Moser, Topeka, Kan., desires: 1. Explanation of the construction of an oscillation gas valve. 2. The theory of the action of such a valve when used as an amplifier and as an oscillation generator.

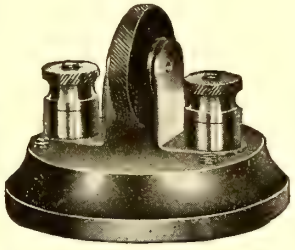


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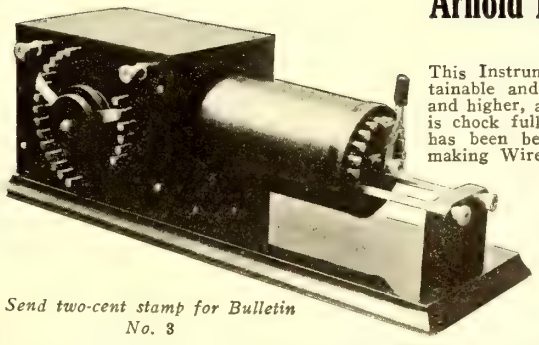


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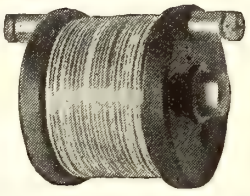


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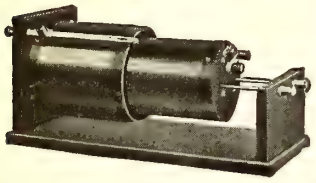
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READ the Classified Advertisements in this issue. They are small but contain big bargains and opportunities.

3. The method by which the recent tests from Arlington were carried out.

A. 1. The oscillation gas valve or audion consists of a glass bulb within which is mounted a small lamp filament, preferably of tungsten or tantalum, a small grid made by winding nickel wire in a zigzag shape and a small plate of nickel. The bulb is exhausted by means of a vacuum pump and sealed off. Connections are made to the ends and the center of the filament, to the grid and to the plate or wing.

A. 2. Such a valve and its operation as amplifier is discussed at length in the January, 1915, issue of this magazine on page 488, but, briefly speaking, the theory is as follows: When energy flows into the tuning apparatus it causes an increase in the number of ions given off by the glowing filament. These ions lower the resistance between the grid and wing, and cause a momentary flow of current in the phone circuit. This circuit contains inductance and capacity, and will therefore oscillate. This current oscillating in the phone circuit reacts on that in the tuner circuit, which in turn further affects the ions flowing through the vacuum, causing an increase of the oscillations in the wing circuit. This action repeats itself and explains the amplification of signals. The above effect takes place when the grid circuit is not tuned to the same wave length as the tuner circuit. When the inductance and capacity in the wing circuit is nearly equal to that in the tuner circuit the oscillations set up will react on the incoming signals to produce beats. By this means it is possible to receive undamped waves.

A. 3. In the recent radiotelephone tests from Arlington to Honolulu and Paris 300 Kenotron tubes were used at the transmitting end and each tube handled ½ kilowatt of energy. The microphones were connected in the circuit in such a manner as to control the ionic flow in these tubes. In this manner the high frequency currents flowing to the aerial were controlled. At Honolulu and Paris elaborate receiving sets were installed which included audion amplifiers.

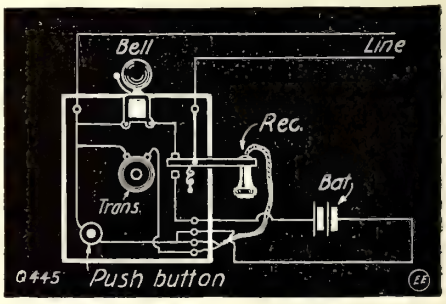
MAGNETO CONSTRUCTION.

(445.) Arthur Paul, Hilton, N. J., sends us a drawing of the armature of a small magneto he is constructing from parts of a motor-cycle magneto and desires information: 1. On the size of the wire, etc., required to finish the machine. 2. Why the coupler he has constructed will not respond to wireless signals, although it seems to be all right when tested with battery and buzzer. 3. The connections for a small, short-range telephone he has under construction.

A. 1. The armature of your magneto should be wound full of No. 24 S. C. C. or enameled wire and a two-part commutator placed on the shaft. The leads from the coil are to be soldered to the segments of the commutator in the usual manner, and two brushes should be arranged to take off the current. With this arrangement and the machine running at about 1,800 r.p.m., you will obtain in the neighborhood of 8 volts and 4 amperes if the magnets you use are of standard strength.

A. 2. It appears that there is an open circuit in your coupler through which the buzzer test has no trouble in flowing, but the current received in the aerial is not strong enough to break down the resistance at this point. We suggest that you examine the coupler carefully and look for open circuits, paying particular attention to the connections between the secondary coil and the leads to the rest of the instruments.

A. 3. We show herewith the proper diagram of wiring for your short-range tele-



Short Range Telephone Set Hook-up.

phone. The transmitters and receivers are connected in series, and the batteries at both stations should assist each other.

AUDIONS.

(446.) D. Currair, Binghamton, N. Y., asks us for information on the construction of the audion detector.

A. In our answer to questions No. 444 we give information on the constructional details of audion detectors. We would like to say that it is practically impossible for an amateur, unless equipped for extra fine glass blowing, to construct these instruments, and only satisfaction can be obtained from the factory-made apparatus.

TRANSFORMERS.

(447.) Carl L. Flory, Eaton, O., writes us, stating that he has a transformer which steps 110 volts up to 880 volts. He desires to know the dimensions of a transformer which would step this 880 volts up to 20,000 volts or more for wireless purposes.

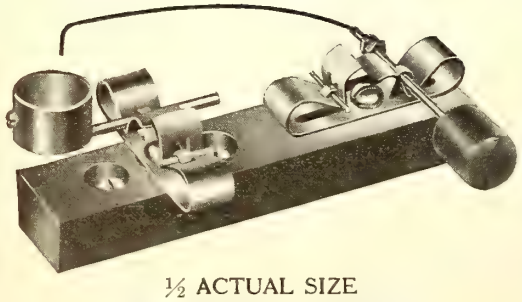
A. We do not approve of the use of two transformers as you suggest, although the scheme will work. It is much cheaper in the end, and the apparatus will be more efficient, if a single transformer is constructed that will deliver 20,000 volts when operated direct from the 110-volt supply.

XMAS CHEER VIA WIRELESS.

Christmas greetings by wireless were sent by President Oswald Becker, of the Davenport (Ia.) Rotary Club, to the heads of Rotary clubs in eleven cities in Iowa and to Omaha, Neb.

The novel form of "Merry Christmas" was relayed out of Davenport by W. H. Kirwan, construction superintendent of the Otis Elevator Co., who has established one of the most powerful radio stations in the Middle West at his home.

Since setting up his radio station Mr. Kirwan has organized a large number of the young men interested in the science into a club for study and practise. He was formerly in the naval service of the United States and served as an electrician in the Spanish-American War. He daily intercepts messages from the United States Government station and from stations all over the United States.



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PATENT ADVICE

Edited by H. GERNSBACK

In this Department we will publish such matter as is of interest to inventors and particularly to those who are in doubt as to certain Patent Phases. Questions addressed to "Patent Advice" cannot be answered by mail. Sketches and descriptions must be clear and explicit. Only one side of sheet should be written on.

MERCURY ARC LAMP.

(43.) R. E. Benson, Trinity, Texas, has submitted to us a novel mercury arc to be used in connection with a motion picture machine. He wishes to know if his invention is practical and whether it will do the work. He furthermore desires to know if it would be a paying improvement. Also, from whom he can obtain explicit information concerning the mercury arc.

A. The scheme submitted is indeed novel and although it will not work exactly as shown in our correspondent's drawing, for the reason that the mercury arc cannot be maintained in a fixed position but must be changed when lighting and extinguishing, we think that by adding several minor improvements the idea can be worked out successfully. We think that an improvement of this kind might work out to advantage, although we do not venture to say that the public would like green moving pictures which result from using a mercury arc. However, by interposing color filters, the greenish light might be done away with, although this is a very difficult thing to do with the mercury arc lamp for the reason that it has no red rays in it whatsoever.

We would advise our correspondent to get in touch with the Cooper Hewitt Co., Hoboken, N. J., and by sending for their catalogs, etc., much information can be had as to the mercury arc and its functions.

NON-REFILLABLE BOTTLE.

(44.) M. Robertson, Nyack, N. Y., submits sketch and description of a non-refillable bottle; he desires to know if it is patentable and if it is of any value.

A. This bottle, like many other non-refillable bottles of which several thousand have been patented in the past, undoubtedly shows some novel points, but we are not sure whether it can be patented on account of so many patents existing in the art. The wisest thing to do would be to get in touch with a patent attorney and obtain references on non-refillable bottles and see what has been accomplished before. There is undoubtedly a market for a simple non-refillable bottle that should have the following advantages:

The device must be cheap to construct and must be made in such a manner that it cannot be detached from the bottle without actually breaking the latter. It should not have any metal parts if possible, as some liquids, particularly spirits, do not improve if they come in touch with certain metals.

AUTOMATIC ELECTRIC CONTROLLED GATES FOR GRADE CROSSINGS.

(45.) Bertram Farnham, East Saugus, Mass., claims to have invented a system of automatic electric controlled gates for grade crossings. The train is supposed to ring a bell, work a signal and put down the gates and raise them again after passing of the train. He wants to know if such a device should be patented and if it is of any value.

A. As stated before in these columns, the railroads as a rule do not favor electrically controlled systems as they are not reliable enough from one season of the year to the other, but without knowing the merits of the invention it is impossible to state our full opinion.

In some sections of England there exists to-day automatic electric controlled gates, but we do not know how successful they have been. There is, however, no doubt in our mind that systems of this kind will come into vogue more and more.

ANTI-COLLISION DEVICE FOR RAILROADS.

(46.) V. G. Johnston, Marshallville, Ga., informs us that he has a satisfactorily working device for the prevention of head or tail-end collisions on railroads by employing a method for signaling in the cabs of the respective locomotives in danger. Our correspondent states that the whole outfit will cost approximately $10 to install, and he furthermore wishes to know our views concerning the device, if the railroads would be interested in such an idea provided the scheme works entirely satisfactorily.

A. Without knowing the nature of the invention, it is impossible to give intelligent advice. Merely a low price would not interest the railroads if there were some functions connected with the device that did not make it entirely "fool-proof" under all conditions.

Railroads usually look askance at devices of this kind, particularly electric devices that work by contact, for the reason that they work well in good weather, but they might not work in case of a snowstorm, when ice covers the right of way or in case of a wash-out.

It is always well to bear in mind that the average railroad accident does not happen under usual conditions, but rather the unusual, where the human element does not perform its functions as it should. The average railroad man, although he is cautioned against it, thinks that certain accidents will never happen on account of certain conditions, and it is usually on account of taking things for granted that accidents do happen.

We would advise our correspondent to get in touch with a patent attorney as soon as his invention has been perfected.

PATENTS

IF YOU HAVE AN INVENTION which you wish to patent you can write fully and freely to Munn & Co. for advice in regard to the best way of obtaining protection. Please send sketches or a model of your invention, and a description of the device, explaining its operation.

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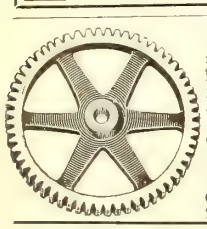
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HOW VESSELS AT SEA SIGNAL THROUGH THE WATER.

(*Continued from page 534.*)

tween two discs drawn together on the tube by a one-inch steel rod and a right-and-left-handed screw thread.

Telegraphing with this Fessenden oscillator is accomplished by means of an ordinary telegraph key placed in the main armature circuit. No undue sparking takes place at the contacts of same; this is due to the fact that the armature has substantially no self-inductance and thus no eddy currents are generated in the apparatus. A 500-cycle alternating current is used. The apparatus is usually of considerable size and is rated at several kilowatts.

When the oscillator is placed on a vessel or hung overboard, a large water-tight diaphragm is attached to it. This particular form of oscillator was first tested between a lightship and a tug 31 miles apart. A later test under severe conditions has established the fact that signals may be transmitted reliably upward of 20 miles, while the vessel transmitting the signals is running at full speed. Quite remarkable indeed is the fact that the Fessenden oscillator may be in turn used for receiving the sound waves, due to the fact that the alternating current reaction is similar to that of motors of the alternating current induction type. In most cases, however, the usual microphone picks up the sound waves which are transmitted by such oscillators.

A very important field for these submarine signals is that involving submarines. These little terrors of the undersea, especially when running submerged, have scant means at their command to communicate with any sister vessel or with the mother ship. In the United States navy tests made

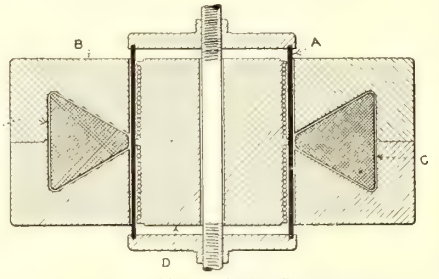


Fig. 3. Sectional View of the Fessenden Oscillator for Submarine Telegraphy.

with these submarine signals some time ago reliable communication was established and maintained for a distance of several miles between boats. It is also possible for a submarine to signal any vessel equipped with submarine signaling apparatus that she is in distress, and it is also possible for lifeboats to carry a submarine signal bell, so that in case they should be estranged or lost during rescue work at sea they could send out distress signals giving their locations, etc., in order that the ship to which they belong will know what to do. Science will eventually rob the sea of all its terrors, or at least those besetting the traveler.

THE RADIO PROFESSION.

One profession that is not overcrowded in the United States is that of the radio operator. The United States in case of war would find it a difficult matter to secure enough professional operators for all of the ships and stations. In that emergency the Government's only resource would be the 250,000 amateur operators in all parts of the country, who really accomplish excellent work in this interesting field. Many are just bungling beginners, of course, but there are also a large number of competent operators among them.



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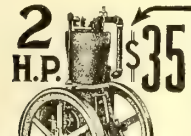
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THE TRENCH TRACTOR.

(*Continued from page* 536.)

induce the men to leave their trench, and, secondly, if they persist in remaining they stand a good chance of being bayoneted or otherwise becoming exterminated by their foes. Incidentally the tractor, being enveloped in a cloud of steam, is protected in a certain degree from the enemy's shell fire.

If a dozen or more tractors of this kind were sent against a line of trenches, it is difficult to see how the enemy could hold them.

"So far so good," my wise friends will observe; "but suppose the enemy, too, has Trench Tractors. Suppose that the 12 French Tractors rush against the 12 German ones. What then?"

In answer to this the writer points to the submarine war and its recent collapse. As long as the submarine could not be combated it raised havoc, the same as the Trench Tractor will raise havoc till it can be combated. But the submarine is now combated by the electric submarine "ear," and the battleship—but a few months ago relegated to the scrap heap—has come into its own once more.

So it will be with the tractor. It will make trenches untenable and thus its importance becomes inestimable indeed, for it will put the men in the field, *where they belong*, not in the trench scrap heap. No war can ever be won if the men stay in the trenches. If there had been no trenches the European war would have been over in six months.

THE ELECTRO GYRO-CRUISER.

(*Continued from page* 543.)

mor of (h), serves double purpose as armor and as the bearing seat and guide for a system of huge ball bearings; (m) is a ball bearing five feet in diameter and probably of solid steel; (m) and its fellows roll in the space between (1) and (l).

This system of bearings will be able to carry a weight of thousands of tons at a rotation speed of 60 miles an hour—which would be only 30 miles an hour between the ball and either one of the bearing surfaces—with minimum friction, wear and trouble, and with the maximum reliability of any system which may be devised, even as it is so with more modest types of ball bearings.

(n) is a section of the armature res of the very powerful two-speed electric driving motors. The two multi-polar motors are each about 70 feet in diameter. On low speed they will be able to force the gyro-cruiser over rough country and directly up steep grades, while very steep grades will be overcome by a zigzag ascent. On high speed the twin motors will be able to rotate the great wheel at 15 or 16 revolutions per minute, a rate at which the cruiser will be making 60 miles an hour over the road.

(o) is an armature coil; (p) is a field coil; (q) is the field core; (r) is the commutator; (s) is a brush which plays between the commutator and the slip rings (t).

The brushes are mounted on miniature electric trucks which run upon a circular track laid inside of the commutator, and their velocity of movement over the track, as well as their position at any time, is controlled from the bridge. The significance of this method of control may be seen upon a little reflection.

(t) slip rings mentioned; (u) is the space in which is the commutator controlling the rotating magnetic fields of the liquid gyroscope; (v) feeders running from gen-

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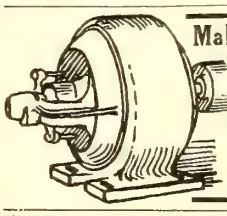


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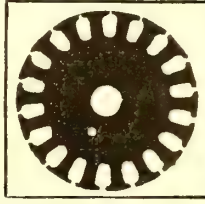
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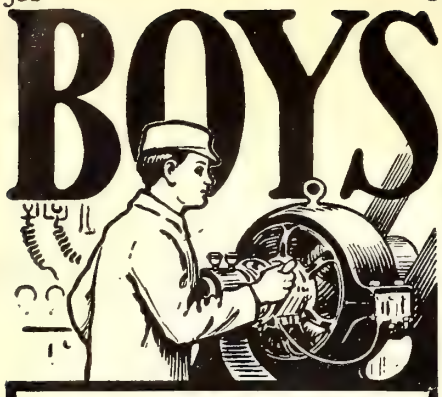
erator to motors; (w) brushes taking current from the slip rings (x); (x) slip rings; (y) feeders from the brushes (z) to the slip rings (x); (z) brushes taking current from the generator's commutator; (Z) commutator of the generator; (Y) armature of the generator; (X) field coil; (W) field core; (V) is the shaft direct connecting the 40,000 horsepower generator to the 60,000 horsepower Diesel engine; (U) bearings; (T) crank case of the engine; (S) cylinders; (R) exhaust; (Q) oil and water intake pipes; (P) partitions and fuel storage tanks; (O) is a passage between the fixed and the rotating structures.

Despite the rotation of the great wheel the engineers' force will have their regular stations. Provision will be made for the protection and comfort of the men who must work in this structure. The rotation will be at the maximum very slow, as we have seen; and it is thought necessary or very desirable that as much of the weight of the gyro-cruiser as may be possible be carried inside and as a part of the great wheel.

(N) is a girder and part of the wheel's framed structure; (M') is also a part of the framed structure. (M) provides additional space for fuel and water tanks and various other storage. In the unmarked spaces of the fixed structure—outside the broken line—will be yet other storage spaces and rooms devoted to crews' quarters and to the thousand and one other incidentals of a giant fighting machine; (L) is a man on tiptoes and arm extended to the foot of the machine. This shows the comparative size. It may here be noted how the sharp foot of the wheel cuts into the earth. This cutting power will be the only "springs" which the gyro-cruiser will need. The bevel and shape of the foot will be a matter of nice calculation and much experimenting to determine the design best combining for an average soil the maximum cushioning effect of the cutting act with the minimum practicable friction between the wheel and the cut.

(K) 50-foot tree shown for comparison; (J) a barbed wire entanglement which, in this case, might as well be made of cobweb; (I) rampart; (H) is a trench with its machine gun helpless and silent to this foe.

We will now consider the liquid gyroscope, the detail, longitudinal section of which is shown in Fig. 3. We will not argue with you as to whether or not it may be possible to construct a solid gyroscope of 2,000 tons weight, or as to whether or not it may be practicable to divide that weight among a number of smaller wheels. We do not think that the one is possible or that the other is practicable, but we will allow anyone his own belief. The first governing condition with which we are met is that the mass of our gyroscope must be driven at an average circumferential velocity of some figure between three and eight miles a minute. Taking eight miles per minute, or 704 feet per second, as a maximum velocity and allowing 40 feet as the average distance from the axis of rotation to the rotating mass, we find that the maximum centrifugal force or bursting effort of the 2,000-ton gyroscope will be 770,500 tons. At a circumferential velocity of three miles per minute the burtsing effort will be 36,200 tons.. It is probable that the gyroscope will not need to be operated at a much greater velocity than three miles per minute, in which case 500 tons of steel in the armored rim (h) would be fully able to take care of the bursting effort. But even if velocities approaching eight miles per minute were found desirable 10,000 tons of steel—elastic limit of 15 tons per square inch—would suffice. This last



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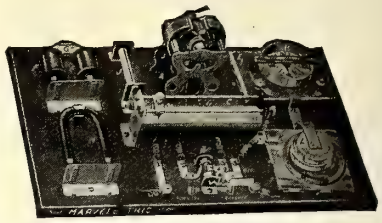
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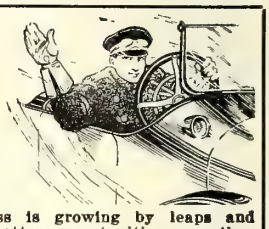
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case would give a cross sectional area of steel in (h) of 100 square feet, which is the area of a triangle, 20 feet at the base and 10 feet in height. These figures reveal the limits within which we must work.

Referring again to the diagram, Fig. 3, we have a circular tube—diameter 100 feet over all by 25-foot cross section—bounded on the outside by the iron case (A) and lined within with non-magnetic steel sheeting (B). (i_1) represents iron rings serving as pole pieces for the magnet coils lying between them. (i_2) indicates spaces in which are wound the large magnet coils encircling the sheath (B). (j_1) is a spiral of non-magnetic steel, and which makes six turns around the inside of the tube in making one circuit. (j_2) is a second spiral which is set one-half turn in advance of (j_1). These spiral guides cause the liquid, when making one circuit around he primary axis of the tube, to make six turns about the secondary axis—which is a circle and is the line joining the centers of cross sections of the tube. (k) are 12 balls of hollow iron shell and structural steel core construction. Each ball is 15 feet in diameter, weighs about 40 tons and has about 10 tons of buoyancy. The balls are held in their relative positions by the magnetic fields of the coils (i_2). Thus, due to these coils, we should find a north magnetic pole between the first ball (k) and the next ball to the left of (k), a south pole between ball No. 2 and ball No. 3, north pole between ball No. 3 and ball No. 4, etc. The liquid to be first employed will be water, although hot, liquid-fusing metals may be later employed, or mercury—if we ever penetrate to the more plentiful deposits of that useful metal which quite likely lie deeper down in the earth's dense bosom. Almost exactly 2,000 tons of water will be carried in this particular gyroscope. This mass will be whirled by the rotating magnetic fields of the coils of (i_2) sucking with them, as they rotate, their armatures, the balls (k). The magnetic rotations will be controlled by the commutator (u) of Fig. 2. Balls (k) will be prevented from coming in contact with the walls of the tube by the centripetal effect upon them of the spiraling motion given to the water by the guides (j_1) and (j_2). This effect is as simple as the parallel effect in a cream separator, that the light c eam goes to the inside, while the heavy milk whirls to the outside. By impressing the spiraling motion upon the water the light, buoyant balls will be held with a great force to the center line of the tube, where, surrounded on all sides by water, they may be sucked by the rotating field at high speed around and around the great circuit with-

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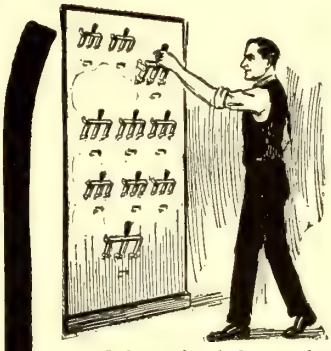
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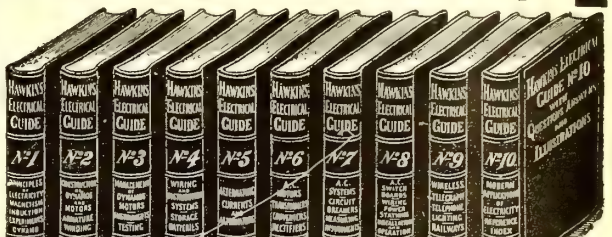
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out suffering or causing any harm and without the gyroscope encountering any friction except the friction of a liquid flowing through a large tube, which, though by no means small, is, fortunately, not of the same order as the friction between a vessel moving in the sea and the water which it passes. This spiraling scheme is the crucial point of the whole idea and is the one thing which raises it from an idle dream to the plausibility and the possibility which it is.

So, in type at least, shall the monsters of the future be created and be set loose upon the land. These giants of a race of toiling machinery will take their places in the trenches which are the valleys, and behind the ramparts which are the hills, and one more freedom will be added to the roll of emancipation and will come out from the nation which loved humanity.

MYSTERIES OF MATTER.

(*Continued from page 549.*)

test state, it is at its lowest point in the scale of evolution, and progress depends on a fall of temperature by radiation. Lockyer's inorganic evolution, joined to the nebular hypothesis, and this to geological and biological evolution, completes the evolutionary cycle of matter to its present terrestrial stage.

We now come to the most interesting, most marvelous mystery of matter. There has been collected a wealth of evidence which proves that the atom is an organized planetary system of dazzling complexity, in which electrons simulate the movements of the planets of our solar system. The negative electrons of the atom swing around the positive nucleus, like planets around the sun. The planet Neptune requires 165 years for a single revolution around the sun, but it has not made a half revolution since its discovery, while the electrons of the atom complete their revolutions around their central nucleus in a millionth or a billionth of a second. The electrons revolve in a series of concentric orbits all in the same plane. While the larger part of the mass appears to reside in the nucleus, the nucleus is relatively minute, with a diameter of probably less than 1/5000 of that of an atom. It is thought that the simpler atoms, such as hydrogen, nebulium and protofluorine, where the electrons are few, all revolve in one ring, but in the heavier and more complex atoms their orbits lie in three to five, or more rings. The atom is as much a machine as an electric motor, and both are electro-magnetic engines.

Nearly the whole mass of the atom resides in the nucleus, but the nucleus is relatively very minute. It is quite impossible to imagine the extreme density of the nuclei. If an oxygen nucleus could be enlarged to a diameter of one inch, its mass would probably be more than 500 tons. If oxygen gas, at atmosphere pressure, could be magnified until the nuclei were each equal to the mass of the sun, we would have the sidereal universe reproduced in which the mean distance between atoms would approximate the mean distance between the fixed stars of the universe. Since the atomic weight of oxygen is sixteen, the atom is supposed to have eight electrons revolving around its nucleus. If we apply the same analogy of magnification to the structure of the oxygen atom, we would have a system of eight satellites in which the relative distances between the revolving electrons and the central nucleus would approximate the distances of the eight planets from the sun. Thus in oxygen gas, the sidereal universe, with its stars and revolving planets, is reproduced in miniature.

It will be seen that the structure of gases

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counterfeit on a very small scale, the structure of the great sidereal universe. Since all the forces acting in the nuclear atom are electrical, may not the forces acting in the stellar universe be electrical? Is not the force of universal gravitation electrical? Should not the universality of law lead us to infer that the force of gravitation is an electro-magnetic force?

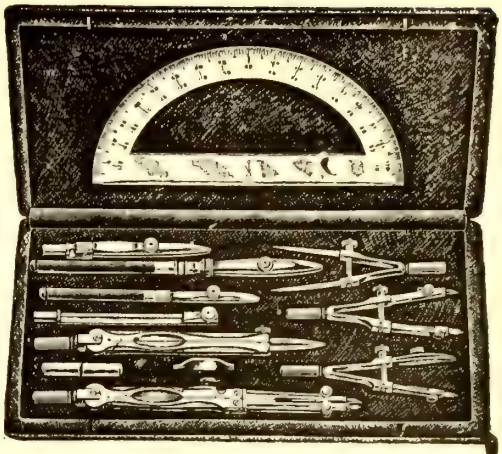
It will be seen from the preceding description that the form of the atom is that of a flat disc, which probably possesses elasticity. It was formerly supposed that atoms were spheres of infinite hardness, and of course without elasticity. The atom, and in fact all matter, is immersed in a medium called ether, which is continuous, frictionless and pervades all space. Ether is the universal carrier of the energy of light, heat, electricity and X-rays. Hydrogen has been called the smallest and lightest of the elements, but the sun, stars and nebulas yield still smaller atoms, called proto-hydrogen, asterium and nebulium. The atoms of these very primitive forms of matter are simpler in their arrangement, and easier to calculate than most terrestrial elements. Working in the dark, the alchemist of the Middle Ages attempted the transmutation of metals, without even knowing the nature of his problem. Science has now unveiled the secret of transmutation, by observing nature's process of changing the heaviest element into a series of different products. The alchemist vainly sought to change mercury into gold. We now know that mercury might be changed into gold, if we could expel from its atoms one alpha particle, and a beta particle; or if the metal thallium could be made to expel an alpha particle, it would become like atoms of gold. This has not yet been done but it is possible that it might be done by the application of an electric current of some million volts.

The principal weight of the atom lies in its nucleus, but the nucleus is very small compared with the size of the atom. It contains so-called "sub-atoms" and electrons, in association with positive electricity. The electric charge of the nucleus is therefore overwhelmingly positive. In the breaking up of atoms by radio-activity, the alpha particles (helium atoms) and the beta particles (electrons) are thrown off from the nucleus. In the outer region of the atom there is a sufficient number of negative electrons to balance the central positive charge. It is this outer region that controls the chemical, and much of the physical influence of the atom. It will thus be seen that the radio-active charge is connected with the nucleus, while chemical and electro-chemical properties are controlled by the outer rings of electrons. It is now known that there are relatively few electrons revolving around the nucleus, probably not more than half of the number representing its atomic weight, in which hydrogen is the unit.

The period of revolution around the nucleus, by the electrons, appears to be identical with Kepler's harmonic law of planetary motion, in which electrical force, varying inversely as the square of the distance, takes the place of the force of gravitation. The lightest atom is supposed to have but one revolving electron. This limits the smallness of the atom, because you could not have an atom with no revolving electron. The smallest atom resembles the earth with its one satellite. The heavy atoms have far greater numbers; an atom of mercury would possess a hundred electrons, which is ten times as many satellites as Saturn has.

Lockyer has shown that the younger and hotter stars contain elements fewer in number, and simpler in structure, than the

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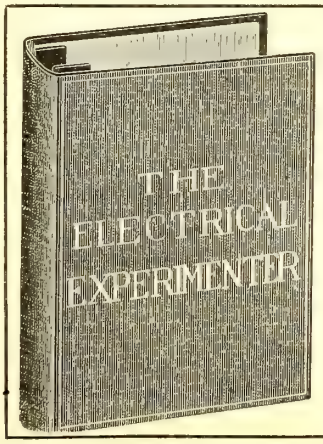
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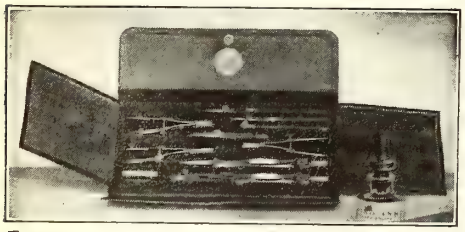
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older and cooler stars. In this fact we face the gigantic evolution of matter from the primitive source of the universal ether, to the complexity of terrestrial organic matter. The mighty machinery of the cosmos is immortal in its operation. Ceaseless change is the only constant thing in nature. The complete cycle of change leads matter through all its phases from the simplicity of the hottest star to the complexity of matter in the planets and in our cool earth.

A recent article by O. Lehmann, on the discovery of the formation of liquid crystals, incidentally confirms the theory, that atoms are flat and not spherical. He assumes that the molecules of these crystals are tiny flat plates whose surfaces are perpendicular to the optical axis. He says, "The molecules easily glide over one another in a direction parallel to their flat surfaces," and concludes that the crystals are combinations of plate-like molecules. Since molecules are small groups of atoms, and some molecules consist of single atoms, it follows that disc-shaped atoms would lend themselves to the formation of flat molecules.

It is probable that the atom is elastic; not perhaps by the pressure that could be secured artificially in the laboratory, but by the gigantic gravitational pressure of the interior of the planets and stars. The earth's interior is so hot that if its pressure were released it would explode into gases of very high temperature. The pressure of gravitation near the earth's center amounts to millions of pounds to the square inch, and there matter is reduced to the density of platinum. Under this force liquids yield like a sponge. Owing to the enormous pressure that gravitation imposes on the earth it is compacted into a dense mass as rigid as that of a ball made from nickel steel armor plate.

We now appear to be on the verge of further discoveries in the nature of matter which may lead to a knowledge of the mysterious, unknown, ether. All intelligent people are interested in new information regarding the swift electrons that light our cities, propel our street cars, operate factories, transmit speech, carry wireless messages and serve man in hundreds of ways. A host of eminent scientists have framed a science of radio-activity which has changed the entire theory of matter, involving conceptions that are difficult to explain to those who have not specialized in physical science. Even the accomplished physicist, Sir William Crookes, says that the conceptions of atomic physics are often hard to understand. We are unfortunately lacking in gifted interpreters of physical science, such as the nineteenth century furnished. Darwin, Huxley, Spencer and Tyndall could clearly explain to the uninitiated, in simple words, the most intricate scientific discoveries of their period.—*Popular Astronomy.*

LATEST DE FOREST RADIO APPARATUS.

(*Continued from page 557.*)

nect the high voltage battery to the binding post marked B B. This scheme has another advantage over the old method, for the experimenter may place any voltage across his instrument and vary it by merely operating the switch handle of the potentiometer. A rheostat for regulating the current supplied to the filament is enclosed in the cabinet and is regulated by turning a rubber handle shown on the right of the cabinet. This is something new for the amateur who is interested in audion detector sets.

An instrument for which the amateur "wireless bug" has long been looking is the recording relay, depicted at Fig. 2. which will operate a sounder, tape recorder and a bell by the regular incoming wireless messages. This consists of an ordinary sensitive voltmeter movement which comprises a strong, permanent magnet in which an armature B is placed between the two field poles C C. The armature B is delicately supported in jewels and carries a contact arm D for making connection with terminal E when it is in operation. The recording or ringing instrument is connected in series with the terminals D and E and a source of current, such as batteries, etc., while the armature B is hooked up with the receiving set in place of the regular 'phones.

The operation of this relay is very simple and the explanation is as follows: As soon as a radio message is received the armature B is deflected or turned and in so doing the arm D will make contact with terminal E, which will complete the circuit of the recording device. Although this device can be used with any sensitive detector, it will work better with an audion and better still with an audion amplifier. It should also be understood that this instrument cannot be employed where high speed messages are to be received. As the period of oscillation is very large it is impracticable to use this instrument for high speed messages, but it can be successfully employed for calling purposes, etc., that is, to announce to the operator that someone wants him.

THE DUBILIER MULTIPLE MUSICAL TONE RADIO SYSTEM.

(*Continued from page 559.*)

on oscillator b. Fig. 3 shows the complete circuit, where q is a quenched cap, C^3 the high tension condenser and 1^1 1^2 oscillation transformer.

The apparatus operating on the above principle is shown in Fig. 4. The oscillation transformer is placed upon the back of the cover of the case as perceived. The gap A is of the quenched type and is constructed of silver and copper bar electrodes. The mechanical vibrator B is used for charging the condenser of the oscillating circuit; the current used by the interrupter is regulated by rheostat C, and the amount recorded by the ammeter D. The high frequency aerial current is read by the hot wire ammeter E. The oscillating circuit is controlled by the condenser enclosed within the case and same is regulated by the handle F. The current is interrupted by a telegraph key located on the top of the shelf, as seen. This outfit is operated on 110 volts D.C. supplied either from a storage battery or a dynamo. The complete outfit weighs 32 pounds, which is marvelously light as compared with any other similar type of apparatus now available. The set illustrated at Fig. 4 is of the pattern used on the French military aeroplanes. The British government is also using radio apparatus of the Dubilier type extensively. They appear to mark a new era in radio transmitting set design, at least where small or medium size outfits are required of the minimum volume and weight.

SEATTLE HEARS RADIO FROM MEDITERRANEAN.

A Seattle dispatch says that a wireless operator there has been able to hear distinctly for several days Italian warships in the Mediterranean talking to one another. He heard the cruiser *Etruria* calling the battleship *Carlo Alberto.* "We hear the Government radio at Arlington every night," said the operator, "and are able to listen in on radiophone calls to San Francisco. We frequently hear radio calls from Japan, Russia and Germany."

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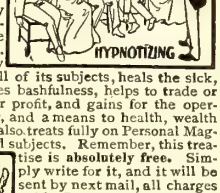
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BINDERS FOR THIS MAGAZINE WILL PRESERVE EVERY ISSUE
SEE PAGE 591.

THE SHIRIKARI TENTACLE.

(*Continued from page 555.*)

without censorship. I wasn't held as close as that, but I know that I never went from one street to another without being dogged by spies, and every letter I wrote or received was read.

"Then came the line-up with Mexico and the war. I at once demanded a settlement and passports and they smiled and said: 'Certainly'—in Jap, you know. That night I was doped and the next day I woke up on board that ship out there—the *A atusa.*"

"What!" exploded the Admiral. "That vessel aground on the Chulavis Bar?"

Forsythe nodded as he drew into a spasm of recollection.

"Yes! Her Captain is a renegade 'No Country' man and the crew are the same. They are paid by the Japs to handle the Tentacles and they loaded sugar at Manila as a blind and then ran her in here with an alleged crippled engine and put her on the bar."

The Admiral turned to one of his officers and growled hoarsely: "Go back to the ship, sir, and signal every vessel in the bay to train its guns on that *Aratusa.* Then take a party over in the launch and demand surrender. Instantly, Mr. Stevens!"

Forsythe's eyes gleamed and he went on: "The Japs had put me on board to see that the devilish things were handled right, and they tortured me into doing it. See that!"

He held up his hands, the thumbs of which were crushed and distorted out of any recognition if they hadn't been on the hands. Cawthorne ejaculated with horror: "Thumbscrews?"

Forsythe nodded. "They starved me at first when I refused to help them in any way. Then they used the screws and I had to give up—I had to! That Captain is a devil, incarnate, among devils as bad as himself!"

"That ship is driven by turbo-generators—that's why the Japs bought her. They can work up to twenty thousand volts if they want to. The winding is very peculiar, after the wonderful Haye-Abbot system, and the current it makes has action and qualities different to anything known before. You'll see all that if you get onto that ship."

"But how did they transmit it, Forsythe?" muttered the Admiral, impatiently.

"Tiny submarines!" groaned the man. "My special invention. They run out with a fine composite wire cable through which they are directed and through which that current is shot after they fasten onto their prey. They're not over four feet long and a man can carry one of them. In the head of each is an electro-magnet with pull enough to hold onto a steel hull. Then the high voltage Haye-Abbot current is switched in; runs through the vessel and back through the air, by wireless—the wonderful Swartson antenna, a bit developed."

He groaned in weakness and pain, but in a few moments he rallied and continued: "You'll find 'em on board—all the stuff. That vessel has a double sheathing, you know; partly used for water ballast, and there's thirty of those Tentacles stowed away in those tanks. That's why the port authorities who came aboard after the accursed captain had run her aground didn't see anything suspicious. They didn't see me, anyway, for I was bound and gagged and stowed in one of those tanks."

He sank back on the cot, gasping. The doctor gave him some stimulant and presently he said: "They ran her on the bar so that they'd have an excuse for running their engines. Claimed they had a bad leak and had to pump. When any outsiders came aboard

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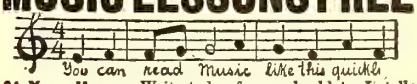
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City State

they were operating pumps; when they were treating your vessels they were operating the generators. You couldn't tell out there, a mile or more away, what they were doing."

"How did you escape?" murmured Cawthorne, his voice and eyes filled with sympathy.

"It was last night, or sometime—I don't just know when. They were planning a night attack on one of your ships and I was forced to direct the adjustment of the little submerging tank of the Tentacle. They were slipping it overboard and I saw a chance to slip, too; and I did. I managed to swim through those breakers and got ashore, with a boat right behind me. Then I scrambled up to the shore road and just as an auto came along I fainted. Woke up here in the hospital."

The boom of a gun came from over the bay. The Admiral exclaimed: "My God! If they fire on that ship they'll destroy all that we ought to see. Come, gentlemen! We must go back."

A shot had been fired over the *Aratusa* as a demonstration of real business, but the launch sent over to take possession was not resisted in any way. The Captain and crew had taken to the boats and dashed ashore, and the Lieutenant went aboard a deserted ship.

* * * * * * * *

Everything was found as Forsythe had stated. In the tanks were stowed twenty-three of the curious little Tentacles, which on being opened and examined showed marvelously ingenious mechanism and just as marvelous workmanship. The salient feature was the control disc, which Kilroth instantly recognized as a perfection of Marvin's invention, but never before put into practical use.

In the report sent to Washington the description of the astounding Tentacles was briefly as follows:

"It is propelled by a moderate current through the attaching wire conductor, a marvel of strength and transmission qualities, but the composition of which has not yet been determined. The submerging tank holds the Tentacle at apparently any desired depth, and the aluminum floats attached to the conductor also holds that at the required depth, taking the weight off the Tentacle and requiring only traction power. A device of amazing electro-mechanism provides that if the wire conductor is broken at any point a clipper cuts that wire close to the Tentacle, and at the same time an inlet valve is opened into the submerging tank and the Tentacle sinks to the bottom of the ocean. This means that the discovery of any one of these Tentacles is avoided by the simple expedient of severing the wire at the tender—the *Aratusa*—and the Tentacle instantly sinks from any detection. The short length first discovered had been broken by some accident—probably contact with one of our submarines—and was instantly clipped off at the Tentacle, which now lies at the bottom of the bay.

The *Aratusa* must have sunk—perhaps to escape detection—seven of these Tentacles, in its week of operation in this bay, for Forsythe states that thirty were on board and only twenty-three remain. This man—the inventor—also states that the return of the current through the air was by special construction of the wireless telegraph antenna of the *Aratusa,* which received the return current from the smoke-stacks or fighting masts of the vessel that the Tentacle was attached to.

"It is respectfully suggested that an acknowledgment be made by the Naval Board, or by the President, of appreciation of the inventor. Forsythe's disclosure of this terribly effective weapon. His distress at his inadvertent work with the Japanese while they were on friendly terms with us, resulting in his tortured compulsion to continue that work against his own country, will surely result in death unless he is, in some way, comforted."

* * * * * * * *

THE MARVELS OF MODERN PHYSICS.

(*Continued from page* 556.)

the number in a stream of such particles and measuring the charge of the total number; then, by division, he obtained the charge of a single particle.

The late M. Curie and others believed that those particles in some way form an elemental magnet, which they have termed the *magneton,* and so the field, instead of being exhausted, is just opening up and scientists see ahead of them explanations of many of the old puzzling questions concerning electricity, light, matter and energy.

The foregoing experiments only serve to illustrate what is really happening in the scientific world and how progress is continual, though striking inventions may only come at intervals. Marvelous as the results already achieved seem, they are only the beginnings of greater marvels the future has in store for us.

RADIO AND ELECTRICAL ENGINEERS MEET AT 'FRISCO.

At the Panama-Pacific convention of the American Institute of Electrical Engineers, held at San Francisco, Cal., two of the sessions were joint sessions with the Institute of Radio Engineers. The first of these was held on Thursday afternoon, September 16, in the building of the Native Sons of the Golden West, R. B. Wolverton presiding.

A paper by Harris J. Ryan and Roland G. Marx, entitled "Sustained Radio-Frequency High-Voltage Discharges," was presented by Professor Ryan.

This paper described experiments made upon discharges in air at 60 cycles and at 88,000 and 188,000 cycles per second. The experiments included discharges from a single electrode, between a blunt point and plate, and the corona about a wire. Diagrams of the apparatus and photographs of the discharges were included. A sphere gap was used for measuring voltage. The ability of the radio-frequency brush to produce thermionic conduction through glass, porcelain, quartz, etc., was found to be its most remarkable property. The application of high voltage at high frequency to a porcelain insulator was found to produce hot conducting cores in the porcelain. No insulation supporting a conductor under such conditions can endure unless so designed that no air in contact with it is overstressed. The eyclograph was used to measure energy and power-factor. The following conclusions are reached:

Sustained radio-frequency corona brushes or flames once started are maintained at much lower voltages than those required to start them by overstressing and ionizing the atmosphere. They quickly destroy even the most refractory insulations by their heating and ionizing properties. The power-factor of the charging current of a conductor in corona due to the application of sustained radio-frequency high voltage is decidedly lower than the corresponding power-factor at low frequencies. Nevertheless, because of the high values of the currents that produce the radio-frequency coronas, the losses they cause may be hundreds of times the corresponding low-frequency losses.

THE WAR AND PROGRESS IN RADIOMECHANICS.

The war has led to a considerable development of radiomechanics. Among the things claimed for it is the ability to blow up the magazines of warships, to steer torpedoes in water, to drop torpedoes from airships and steer them to a goal on land, and to blow up bridges and fortresses.

To obtain a rational opinion on the question, the *Petit Parisien* asked for a statement from Prof. Branly. Prof. Branly, who is a Catholic priest, is known to scientists and students throughout the world. He is one of the men to whom the success of wireless telegraphy is due.

"It is possible to produce at a distance mechanical effort of any kind, but it is always necessary that the object to be affected be provided with apparatus receptive of electric waves. It would consequently be possible by means of radiomechanics to blow up at a distance a bridge or a fortress if the object to be destroyed were previously equipped for the purpose; that is, if it were fitted with a special apparatus. The consequent difficulties that supervene it would be superfluous to enumerate.

"As for operating from a distance torpedoes or submarines or dirigibles, which without crew or pilot should execute a work of destruction, that also would be possible. So far it has not been done in this war. It is obvious that an unexpected electric spark of atmospheric origin or coming from the enemy's side might provoke the action at a most inopportune time and in a most undesirable manner.

"In the field radiotelegraphy has proved itself most serviceable, as all know. The Germans make ample use of it. Their headquarters is thus united to Antwerp, to Brussels and to Lille. Radiotelegraphy was of great service to the 11 German warships which kept the sea for some months, doing a work of destruction. But it was also of service to the Allies for the discovery and destruction of those ships.

"As for the possibility of the enemy having on our territory hidden stations for radiomechanics, from which at a given time damage might be done, I doubt the utility of such a project. It would be easy enough to hide the antennae, but it would be impossible to hide the machinery," he intimated.

COLLEGE RADIO SET.

Prof. H. E. Robbins is at work on plans for installing a wireless telegraph station at the Agricultural College at Amherst, Mass. He has secured a 10,000-volt, three-quarter kilowatt transformer, crystal detector and head phones, and has applied for a room over the sophomore physics laboratory for the [illegible]. He proposes to

THE ELECTRIC ARC AND ITS INTERESTING APPLICATIONS.

(*Continued from page* 560.)

For the purposes of radio communication a smaller capacity and inductance should be used unless very high wave lengths are wanted. The inductance can be of the ordinary type oscilliation transformer, and variations in same can be made by means of clips.

Besides the uses enumerated above the arc has the very interesting property of being one of the chief factors requisite to the measurement of inductance and capacity, and is so used at the Bureau of Standards laboratories and elsewhere.

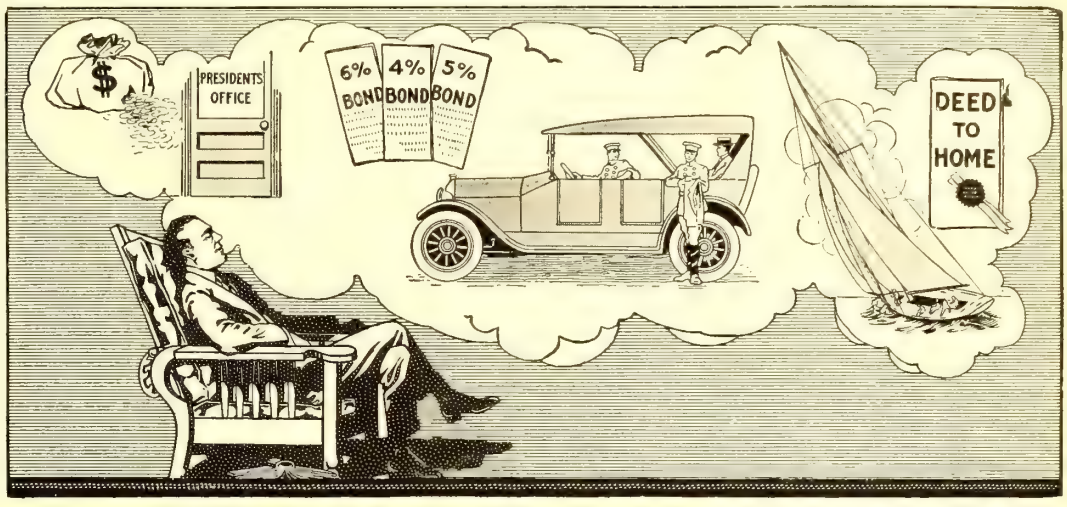
If at all possible for the experimenter to obtain the use of *direct current* it will certainly pay him to carry on investigations with this type of arc, as it will prove very interesting and instructive, and surely there is a large field for new discoveries.

Caution: When experimenting with the electric arc the eyes must be protected invariably by wearing "black" eyeglasses, procurable from any optician.

POPE TO BLESS WIRELESS.

The Exchange Telegraph Co.'s Rome correspondent says:

"Vatican circles announce that the Pope is preparing to bless wireless telegraphy officially, thus restoring the ancient custom of the Church to bless inventions which confer great benefits on humanity."



Partial Contents

The Law of Great Thinking.
The Four Factors on which it depends.
How to develop analytical power.
How to think "all around" any subject.
How to throw the mind into deliberate, controlled, productive thinking.
Detailed directions for Perfect Mind Concentration.
How to acquire the power of Consecutive Thinking, Reasoning, Analysis.
How to acquire the skill of Creative Writing.
How to guard against errors in Thought.
How to drive from the mind all unwelcome thoughts.
How to follow any line of thought with keen, concentrated Power.
How to develop Reasoning Power.
How to handle the mind in Creative Thinking.
The Secret of Building Mind Power.
How the Will is made to act.
How to test your Will.
How a Strong Will is Master of Body.
What creates Human Power.
The Six Principles of Will Training.
Definite Methods for developing Will.
The NINETY-NINE METHODS for using Will-Power in the Conduct of Life.
Seven Principles of drill in Mental, Physical, Personal Power.
FIFTY-ONE MAXIMS for Applied Power of Perception, Memory, Imagination, Self-Analysis, Control.
How to develop a strong, keen gaze.
How to concentrate the eye upon what is before you—object, person, printed page, work.
How to become aware of Nerve Action.
How to keep the body well-poised.
How to open the Mind and Body for reception of incoming Power.
This is only a partial list —a complete list of contents will be sent you.

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Your Will Needs Practice

If you should stop work for two years and have no occasion to use your brain in solving business problems, you would gradually become unable to use it as you do now, simply from lack of practice. It's continual practice that makes it possible for you to arrive at quick decision and enables you to see the solution of vexing problems quickly. And you'd be surprised how soon the gift would leave you were you to get out of the harness for a few years.

The same is true of the Will. Because we don't use it, we don't know how. Most of us float along carrying out other people's wills simply because our own will has become scotched and dormant from lack of use. Yet the Will is just as susceptible to training as the brain or memory and by the very same methods, by intelligent exercise and use.

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"He who reads it and puts forth effort will soon find himself out of the common herd."—F. A. Good, President of Nebraska Lumber Dealers' Assn., Cowles, Neb.

"Here is $3 for you. 'Power of Will' received. It is the book I've wished for for years."—J. L. Seawall, Clerk of Supreme Court, State of N. Carolina, Raleigh, N. C.

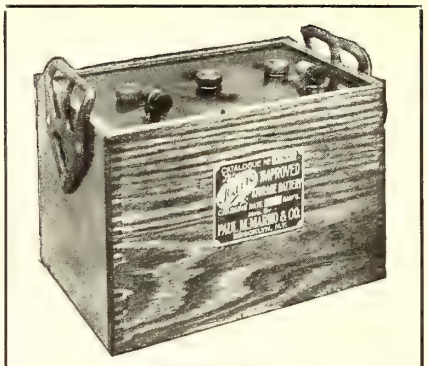
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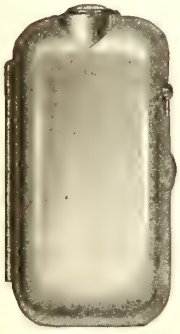
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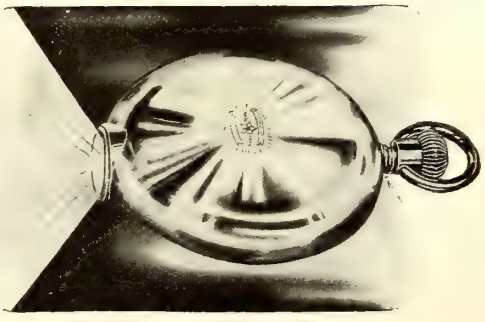
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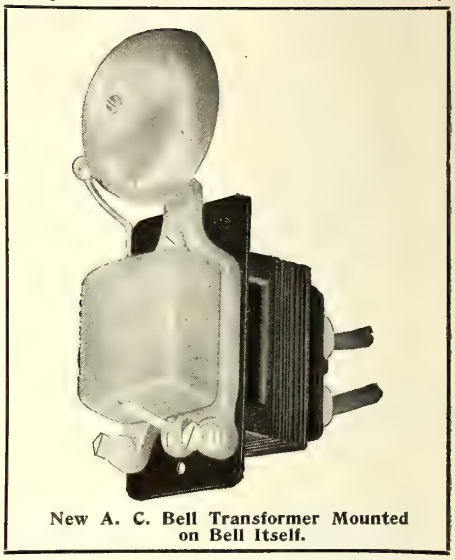
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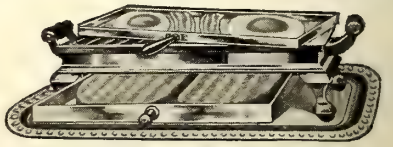
New A. C. Bell Transformer Mounted on Bell Itself.

HEAT CONDUCTION IN SELENIUM.

The fact that selenium changes its electrical conductivity so markedly with illumination has no doubt led many investigators to consider the possibility of a change in its heat conductivity with a change in the illumination. Bellati and Lussana, experimenting with a thin disk of light-sensitive selenium, found such a change and also noted that the percentage change in the thermal conductivity agreed well with the percentage change in the electrical conductivity where exposure was made to the same light. L. P. Sieg, in the *Physical Review,* mentions experimenting on a selenium crystal, and found that while the given source of light increased the electrical conductivity nearly 300 per cent., the same light did not increase the thermal conductivity in any appreciable manner; considering all possible sources of error, it must certainly have been under five per cent.

UNIQUE ELECTRIC STOVE.

A very neat electric stove has recently been brought out by a Western manufacturer, as a glance at the illustration will confirm. It combines four functions in one; in other words, it can be used as a toaster, a griddle, a broiler and a stove. The manufacturers guarantee it for five years. It comes complete with drip pan or tray, and also with a toasting pan, which slides in under the heating grids, besides a frying



Electric Stove of Many Uses.

BOOK REVIEW

WIRELESS TELEGRAPHY. By Dr. J. Zenneck. Translated from the German by A. E. Seelig, E.E. 443 pages; 469 illustrations; 6½x9½ inches. Cloth bound. Price, $4.00. 1915. McGraw-Hill Book Co., New York.

The latest acquisition to technical radio literature is here offered in this volume by Dr. Zenneck, the well-known wireless scientist. Much new matter is given in very attractive form of value to the general and advanced reader. A large number of important topics are covered mathematically and otherwise in an interesting manner. Some novel ideas are brought out on wave phenomena and particularly their propagation over the earth. The shape of the wave as it passes along the surface of the globe and the probable manner of overcoming such obstacles as hills, etc., is quite exhaustively treated upon. The author is an able authority on this subject and the reader will learn much by a perusal of this section as well as the very illuminating and lucid chapters on the natural oscillations of condenser circuits; open oscillators; coupled circuits; resonance curves; the antenna; undamped oscillations by the arc method; detectors; receiving circuits and their design; directive radio-telegraphy, etc., etc.

It is practically impossible to cover all the necessary laws and data on such a rapidly growing subject in a single volume, but this work is highly commendable in every way and should be read by all radio men. It seems as though the sections on arc type radio frequency generators, detectors, and high frequency alternators might have been advantageously extended. Some empirical deductions are cited in the chapter on "directive telegraphy" concerning the Marconi inverted "L" type antenna which seems somewhat far-fetched, in view of the fact that these antennae are in actual use by the Marconi Co., for long distance radio transmission over the Atlantic and Pacific oceans.

CHEMIST'S HANDBOOK. Issued by The International Correspondence Schools. Cloth covers; 5½x4¾ inches; 332 pages; 5 illustrations. Published by International Textbook Co., Scranton, Pa. Price, 50 cents.

The astounding part of this volume is the enormous amount of analytical data contained within its covers. It covers chemistry in a brief form and the tables are of use to every chemist, metallurgist or assayer.

The forepart of the book covers fundamental laws, atomic weights, chemical calculations and heat measurement. Analysis is handled in a masterful way with chapters on wet and dry analysis, assaying and blowpiping. The tables of results with different reagents are very valuable and blowpiping is covered in a manner that will be of assistance to anyone interested in this method of analysis and the tables of characteristic reaction cover 31 pages.

For the power plant engineer the subject of coal, boiler water and flue gas analysis is covered in a simple manner that assures the rapid and accurate calculation of the efficiency of steam plants.

TELEPHONE AND TELEGRAPH ENGINEER'S HANDBOOK. Issued by The International Correspondence Schools. Cloth covers; 5½x4¾ inches; 398 pages; 95 illustrations. Published by International Textbook Co., Scranton, Pa. Price, 50 cents.

A compact, reliable treatise on telephone and telegraph practise, the work of specialists in their line, and intended as a reference book for the practical man, aptly describes this little volume.

The aim of this treatise is to select, classify and place in the hands of the "man on the job" information and data that will be of practical assistance to him in his daily work.

The book starts with a brief treatment of mathematics, including various handy tables. Electrochemistry and mechanics are treated of so far as they bear any relation to the work of linemen, trouble-shooters or foremen. Wire tables and formula are given and the circuits in use are treated at length. The diagrams illustrating the latter are exceedingly clear and in many cases are full page drawings.

The latter part of the volume covers telegraph practise in a manner that will interest any telegraphist. A short treatise of wireless telegraphy is given, but this subject is rather briefly treated, only the general principles being given.

The book really gives a brief outline of the correspondence course on the subject by the I. C. S., but the volume will be invaluable to those in the least way interested in telephony or telegraphy.

GIRL BECOMES ENGINEER.

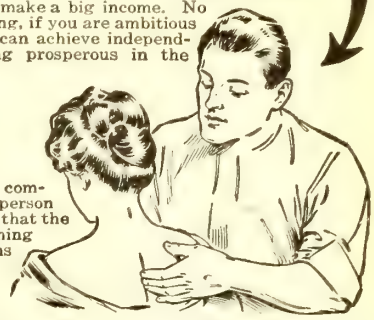
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We believe that *this book contains more information on how to make wireless receiving apparatus than any other book in print* and you will find that it is easily worth double the price we are asking for it.

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UNDOUBTEDLY you have at the present time some things for which you have no further use. Do you wish to exchange them for something, for which you have immediate use? There is no surer and quicker way to do this than by advertising your articles in these columns. The **Very** people, the **Only** people, who could possibly have a use for your things read this journal. More than 40,000 interested people will see your ad. It is furthermore the cheapest advertising medium for you in the country. Dealers' advertising accepted in Opportunity Exchange Columns only.

The rates are: One cent per word (name and address to be counted) minimum space 3 lines. Count about 7 words to the line. **Remittance must accompany all orders.** No advertisement for less than 10c. accepted.

We reserve to ourselves the right to refuse any advertisement **which we** consider misleading or objectionable. Advertisements for the March issue should reach us not later than February 5th.

The Classified Columns of "The Electrical Experimenter" Bring Positive Results.

Subscribers experiencing trouble in dealing with any advertiser should notify the publisher very promptly.

DeFOREST audion detector, type R J 5 (with new batteries and X grade Hudson filament bulb), $16; cost $29. J. S. McDonnell, 3304 Eighth Ave., Little Rock, Ark.

COMPLETE wireless outfit, worth $87.95, and slide trombone, "Frank Holton Special," worth $62 with case; would sell wireless outfit for $40, trombone $30; or exchange all the above for high-powered high-frequency apparatus. Send for particulars. East Germain, Ashland, Mass.

WILL TRADE $20 A. C. S. course in mechanical and architectural drawing (four volumes, like new), for wireless receiving instruments. All letters answered. Harold Shirley, Lebanon, Ind.

EXCHANGE D. C. motor for type A.A. Crystaloi; Motsinger magneto for adjustable tubular sending condenser. E. I. make. Albert Heyman, 227 S. 20th Ave., Minneapolis, Minn.

HAVE a 1½ K. W. transformer. Want rotary gap, audion or loose coupler. No home-made apparatus. Harold Craven, Selma, Cal.

FOR SALE—Electro $7.50 loose coupler, $4; Electro ½ K. W. transformer and interrupter, $5. Instruments in excellent condition. No parts broken. Stuart W. Pierson, Carrollton, Ill.

PERSONAL INSTRUCTIONS in chemistry by expert chemist, 50c. per lesson. Will exchange for wireless or electrical apparatus. Enclose stamp. Elbridge F. Ball, Buckland, Conn.

WILL EXCHANGE commercial job printing for good or burnt-out audion, audion amplifier bulbs, variable condensers, Crystaloi, or offers. Enclose stamp. E. Ball, Buckland, Conn.

FOR SALE—One 4 H. P. Pope motorcycle engine set in iron frame with extra flywheel. Can be used for stationary work, including spark coil—all in good condition. The first ten dollars takes it. All letters positively answered. Emil Roth, Castle Shannon, P. O., Pa.

NOTICE! We buy, sell and exchange wireless instruments. Have many real bargains and have demand for used instruments. Tucker & Dewey, Box 755, Hartford, Conn.

WILL PAY CASH for audion bulb. Must be in good condition. J. Wallace Peckham, Melville, Newport, R. I.

EXCHANGE—Have .32 revolver, Murdock loading coil, Murdock condenser. Want A.A. type Crystaloi detector. Bernard Bisciotti, 608 Carpenter St., Philadelphia, Pa.

HAVE high-grade 1½ K. W. sending and receiving wireless sets, everything complete and in A No. 1 condition, which I wish to exchange for refracting astronomical telescope, must be high-grade instrument, or Harley-Davidson motorcycle side-car. Dr. Mack, 256 Fifth Ave., Pittsburgh, Pa.

SWITCHES FOR SALE—"Electro" aerial switch (new), price $1.35; "Electro" 100-ampere lightning switch (new), $1.25, both for $2.50; porcelain base knife switches, double pole, double throw, each 25c.; double pole, single throw, each 16c.; wood base switches (1 point), 6c. each. Write quick. Louis Menier, 443 E. 85th St., New York City.

FOR SALE—One "Electro" dynamo, type "SS" (new), price $3.20, and one "Electro" 4-inch water motor (new), for $1.85. Both for $4.80, including Universal coupling for water motor. Write quick. Louis Menier, 443 E. 85th St., New York City.

FOR SALE—The first remittance for $2.75 takes a pair of E. I. Co. 2,000-ohm Jr. wireless phones No. 8090, in excellent condition. Beall Taylor, Rivermont Ave., Lynchburg, Va.

FOR SALE—Slightly used Amco humming transformer, $6.75; 1 K. W. helix, $2.50; new $7 Chambers receiving transformer, $5.50; also $12 electric train and track, $4. Want Blitzen $4 and Murdock $3 variables. Will pay cash. Harry McCarthy, Huntingdon, Pa.

FOR SALE—"Climax" concrete brick machine, makes plain and fancy bricks, $6.50; concrete column moulds, rock and panel face, 8, 12, 16 inches, $2.75 to $3.50; round column mould, $3. All in good condition. Sand screen, $1. Lloyd Gress, Pitman, N. J.

WANTED—Constant speed spring motor that will run at least 30 minutes, power stronger than phonograph motor. Also unused audion bulb. Fair prices will be paid for these articles if in good condition. Wm. H. Trippe, Toms River, N. J.

WANTED—Crystaloi resonator; Crystaloi or Perikon detector; variable condenser; 3,000-ohm headset; aerial switch; Electrose insulators; oscillation transformer. Eugene C. Braatz, Lowellville, O.

HAVE large-size static machine for X-ray work, large-size tube and insulated stand. Would like for it a 1 K. W. hytone set or ½ K. W. hytone and audion. Anyone having Blitzen transmitter please make offer. Clayton B. Shelby, Barker, N. Y.

$3.10 giant sounder, 75-ohm phone, 27 wireless magazines, ounce copper pyrite. Want phones or sale. Karl Dueck, Defiance, O.

FOR EXCHANGE—"Caligraph" typewriter, 20-ohm sounder and key, audible telegraph transmitter and reels, three 6-volt 9-candlepower "Mazda" bulbs and sockets. Want headset, loading coil, fixed and variable condensers, potentiometer. J. Walter Briggs, Stanfordville, N. Y.

WIRELESS receiving set, consisting of single-slide tuner, new silicon detector, condenser and 1,000-ohm phone, $5. Elmer Baier, 444 Seventh Ave., Brooklyn, N. Y.

FOR SALE—Audion detector, similar to R J 5 but mounted on top of cabinet; cost $30 and is almost new, but needs new high-voltage batteries. Will sell for $15 (express paid). Act quick. I guarantee audion to be in first-class condition. Peter A. Stover, Marengo, Ia., Box 106.

FOR SALE—Amco $7 oscillation transformer, $4. Never been used. Murdock 2,000-ohm headset, $2.50. Write. Arnold Rufsvold, 3216 16th Ave. S., Minneapolis, Minn.

EXCHANGE — Clark Irish harp, ohm-meter, thermo-pile, galvanometer, auto lighting generator, gas headlights, garage power air compressor with tank. Want engine lathe, prism binoculars, tiger rug, or what have you, excepting books, wireless apparatus, stock or real estate? Joseph Lamb, 563 Baldwin Ave., Detroit, Mich. All stamped letters answered.

HAVE electrical course complete; also Seneca folding camera. Want chemistry books, microscope, telescope and drawing instruments. Roy Heath, Highland Park Station, Des Moines, Ia.

WILL EXCHANGE complete receiving set for Knapp type "SS" dynamo motor. Write for descriptive description and lists. Will pay cash for Brandes transatlantic phones. Will answer all letters. David Goodman, 418 W. Court St., Flint, Mich.

FOR SALE—One No. 5 "Structo" and $5 worth of extra parts, cost $15 new; will sell for $8. One Gem adding machine, cost $10 new; will sell for $6. One Remington typewriter, cost $100 new; will sell for $35. Frederic Peterson, 811 Washington Ave., Red Oak, Ia.

FOR EXCHANGE—One A. C. arc lamp, 60-120 cycle, cost new $35, for battery-charging generator and automatic cut-out. H. B. Rice, Galeton, Pa.

WANTED—A copy of bound Vol. No. 1 and No. 2 of The Electrical Experimenter. Write A. B. Chance, Centralia, Mo., stating price.

FOR SALE—¼-kilowatt transformer and condenser in oak cases. Winger transformer gives 14,000 volts. First reasonable offer accepted. Bayard Shumate, Lebanon, Ind.

FOR SALE—Electrolytic detector, 85c., and E. I. Co. potentiometer, 95c.; both for $1.75. Rosswell Brown, 748 E. State St., Huntington, Ind.

FOR SALE—Transmitting set, including Packard transformer, Sayville rotary gap, two sections Murdock condenser, Clapp Eastham antenna switch, Murdock oscillation transformer and Bunnell key. Will sell for $25, or trade for R J 5 audion in good condition. Carlisle Benjamin, Clyde, N. Y.

ELECTRICAL LIBRARY, I. C. S., nine volumes, $15; head receivers, $2. O. M. Jones, Des Moines, Ia. No. 45 H. P. Sta.

HAVE brand new Nichols sending and receiving wireless station No. 402. Cost $7.25; will sell for $3.25. Carl Barany, 245 W. 35th St., New York City.

A 220-volt 1-12 H. P. enclosed D. C. motor. Want Brandes, navy or transatlantic phones or cash. Henrik Juve, Enterprise, Ore.

FOR SALE—1 K. W. Thordarson transformer, Murdock oscillation transformer, complete unmounted rotary gap (motor 7,000 rev. per minute A. C.), oil immersed condenser. Will sell to first reasonable offer; all answered. Henry Messerly, Staunton, Ill.

FOR SALE—Electro amateur phones, $3; Gernsback variable condenser, $3; Electro loose coupler, $3; electrolytic detector, $1; potentiometer, $1; motor, 50c.; telegraph set, 75c. Harry Holmberg, Bottineau, N. D.

WANTED—Tesla coil X-ray apparatus, ½ kilowatt flexible transformer, 2-inch coil, audion bulbs, burnt-out or good, and heavy key. Every letter answered. Will pay cash. Harry Smejkal, 1349 First Ave., New York City.

FOR SALE—½-inch spark coil, $1.50; spark gap, 35c.; Amco key, 50c.; Radio Apparatus Co.'s key, 35c.; Amco "Little Giant" motor, 35c.; flashlight, 40c. Write to Louis Enslin, No. 21 Street, Philadelphia, Pa.

BARGAIN—Edison standard $40 phonograph, good as new; 150 records; price, $50. Write for particulars. J. L. Dunnell, Northfield, Mass.

WANTED—Back numbers of aeronautical magazines; also The Electrical Experimenter, Vol. 1. What have you? L. Koerner, 312 W. St. Vrain St., Colorado Springs, Col.

FOR EXCHANGE—Stamp collection in Scott's Best Album Cat., over $35. Want printing press, camera or electrical apparatus. Oscar E. Noreen, R4, Gresham, Ore.

FOR SALE—Two telegraph sounders, 50c. each; one electric car and outfit, cost $3, will sell for $1.50; two motors, 50c. each; telephone transmitter, 50c. H. Moersbfelder, 34 Ketchum Pl., Buffalo, N. Y.

MOTION PICTURE FILMS, $1 reel up. Chas. Chaplin, etc. Will trade. If you mean business, write. Enclose stamp. Kenneth Woodward, 24 Lenox St., Uniontown, Pa.

FOR EXCHANGE—I have a complete ½ kilowatt sending set and an audion receiving set, complete, with necessary switches, aerial wire, insulators and two storage batteries; also lots of other electrical apparatus; complete value, one hundred and fifty dollars. Want a motorcycle, or will sell or exchange separately. What have you? Allan Lawson, 108 Walnut St., Waterbury, Conn.

WANTED—Any electrical or gas engines bought; good price. Kenneth Lee, Purcell, Okla.

HAVE 6-volt, 8-ampere D. C. Remy magneto in good condition; cost $10. Can be used as motor. Want good coil, 2 or 1½-inch, depending on make and condition. Kenneth Bard, Manawa, Wis.

WANTED—½ or ¼ K. W. transformer, audion bulb, good or broken, and spark gap. Will trade articles or pay cash. Would like to exchange photographs of stations. Alexander Bollerer, 77 Linwood St., New Britain, Conn.

FOR SALE—A Packard ½ K. W. transformer in oaken case, with power variations controlled by switch, and condenser for the same. Price, both together, $9. Wm. Bride, 116 E. Haverhill St., Lawrence, Mass.

ONE radio 3,000-meter loose coupler, galena, two Universal electrolytic detectors, rotary potentiometer, two 43-plate variables, $10, cost $24. Claxton horn, Stewart speedometer, motorcycle electric lamp, $7, cost $20. Sold separately. Want 3,000 phones, audion detector or bulb, ½ K. W. closed-core sending instruments. H. Hawks, Fleming, Pa.

HAVE telegraph key sounder and about 50 feet of wire to exchange. What have you? M. R. Heslowitz, 151 Peshine Ave., Newark, N. J.

FOR SALE—Edison kinetoscope; also ¼ H. P., A. C. 110-volt electric motor, fluoroscope X-ray tube and centrifuge. H. S. Partee, Biddle University, Charlotte, N. C.

HAVE a motor bike engine, .22 Savage high-power rifle, piano player, single Merkel motorcycle, stereopticon and other articles to exchange for a 2 K. W. 110-volt generator, small lathe, electrical experimental articles. H. A. Margreiter, LaPlata, Mo.

MURDOCK APPARATUS—Loose coupler, $6; loading inductance, $2; detector with condenser in base, $1.50; Blitzen variable condensers, 43 plates, $3; 31 plates, $3.50; all equal to new. Sent P. P. C. O. D. Wm. Ranft, 4107 Belle Ave., Baltimore, Md.

FOR SALE—Type "S" dynamo motor, $1.50; in good condition. Letters answered. Ernest Becker, Isleta, O.

FOR SALE—Blitzen receiving cabinet set; hand bench punch, weight 130 lbs.; metal splitting shear, weight 100 lbs. Write for particulars. C. F. Lee, 1417 Belleplain Ave., Chicago, Ill.

"ARLINGTON" receiving set, only $6, mounted ready for use; gets Arlington loud with small aerial. Send for photo and description. A. Newman, 685 W. Ferry, Buffalo, N. Y.

FOR SALE OR TRADE—Books on adventure, etc. Clean, live and wholesome. Make me at least an offer. For particulars write Chas. Hrdlicka, Lesterville, S. D.

EXCHANGE—Meccano outfit No. 4, $6 motor, high-grade radiopticon and 4 H. P. motorcycle engine. Want wireless apparatus. E. W. Pennington, 3236 Stevens Ave., Minneapolis, Minn.

WANTED—A cabinet receiving set in exchange for moving picture machine, no toy. Have three violins, guitar and xylophone. What have you in the receiving line? Harold Buckner, Morgan Hill, Cal.

FOR SALE—Complete loose-coupled wireless receiving outfit, standard amateur type, including aerial, ground and connecting wire and accessories. Cost $12; will sell for $6. Write for description. H. Frankland, 517 W. 113th St., New York.

EXCHANGE—Set of five electrical books, two-point annunciator, wall telephone and other goods. J. Forsht, Box 861, Lock Haven, Pa.

EXCHANGE—Bass violin 6 feet tall, best condition, except strings, for wireless sending set. R. J. Morrison, Cherryville, N. C.

FOR SALE, Twenty dollars, or separately: Mignon coupler, three thousand ohm telephones, load, fixed and variable condensers, eight Electrose insulators, six mineral detectors, minerals and switches. Meeker, 511 W. 186th St., New York.

FOR SALE—One Eastman No. 3A Brownie and complete outfit in good condition, with developing tank. First money order for $10 takes it. Chester Ickes, Reynolds Dale, Pa.

BIPLANE GLIDER—Upper plane, 24x4½; lower, 20x4½; length 16 ft. New, worth about $60. Will exchange for wireless goods, cyclecar, motorcycle or motor. H. W. Craver, 222 Custer Ave., Youngstown, O.

WANTED—Burnt-out audion bulb; will pay $1.50. Charles Bunker, 114 E. Carter Ave., Ashland, Ky.

FOR SALE cheap, in good condition: Loose coupler, potentiometer, electrolytic detector, single-pole, thousand-ohm receiver and cord. Write Wm. W. Macalpine, 5845 Phillips Ave., Pittsburgh, Pa.

WANTED—A pair of two or three thousand ohm phones and headband. Harry R. Fees, Guthrie, Okla.

FOR SALE—An engine and coal car 2 feet long, three cars measuring 15 inches each, 19 feet of 2¼-inch track, two switches; all cost $40. Will sell for $20. All in perfect condition; selling because interested in wireless. Holden Booth, 3529 Ainslie St., Philadelphia, Pa.

BARGAINS—Nar meter loose coupler, $3.50; American Model Builder No. 6, $7.50. Want ½ K. W. closed-core transformer, rotary gap. All letters answered by Carl Linxweiler, 140 Eagle St., Dayton, O.

TRADE—Type "SS" Knapp dynamo-motor and small medical coil; both in good condition. Want burnt-out audion globe and two sockets for same. Write Tom Sides, P. O. Box 375, Selma, Cal.

FOR EXCHANGE—Rhumkorff ¼-inch spark coil of mahogany woodwork, cost $6 when new, for a good audion bulb. Joseph Terleph, Brown Ave., Jamaica, L. I.

FOR SALE—One 2¾ H. P. Indian engine, $9; one 3 H. P. boiler and engine, including all gauges and governor, with sufficient new pipe fittings to install, $20. Will exchange one 2 H. P. 220-volt D. C. motor, less field coils, for typewriter. Send stamp for particulars. Gregory Fay, 1024 Bellevue Ave., Syracuse, N. Y.

FOR TRADE—Series telephone and telephone parts, magic lantern with five hundred views, musical instruments. Exchange for Omnigraph, tape register, or what have you? S. H. Rudy, R. F. D. No. 4, Fairmont, W. Va.

FOR SALE OR EXCHANGE—Complete wireless receiving or sending apparatus, worth $49.50, for $20 cash; or separate parts sold for one-third price. Send stamped envelope for reply. Write at once. Robert Roth, 2023 Evergreen Ave., Chicago, Ill.

SPECIAL NOTICE—Will sell my Electrical Engineering books, civil, chemical and two $10 medical books, magazines on electricity, such as Electroforce, for what you can offer. Write or send 50c. for samples. Robert Roth, 2023 Evergreen Ave., Chicago, Ill.

BARGAIN! Complete wireless outfit (new), cost $50; will sell for $30 if taken at once. Also have printing press for $2; catcher's mitt, with league, for $3. For particulars write Fred Roewekamp, 202 Wangoo St., Oshkosh, Wis.

FOR SALE—New 2-inch coil, $5.75; Brandes Superior phones, $4; gas postcard projector, cost $5, will sell for $2.50. H. Moershfelder, 34 Ketchum Pl., Buffalo, N. Y.

FOR SALE—12-inch fan, D. C., 1-6 H. P.; $4 takes it. Two-cylinder spark coil (French make), $5. Manuel Rattner & Bro., 36-38 Union St., Poughkeepsie, N. Y.

FOR SALE—½ K. W. induction coil with vibrator, $4.50; ½ K. W. helix, $2.50; and a receiving transformer, tunes up to 3,500 meters, $2.50; five cells Exide storage battery, $30. R. J. Freeman, Aloah Radio Sta., Southampton, N. Y.

FOR SALE—Electro transcontinental receiving set No. 1603, with 3,000-ohm phones, aerial wire, insulators, lead-in cable, wireless course, etc. Cost $33; never been used; $25 takes it. A. G. Afton, 521 Ash St., Osage, Ia.

FOR EXCHANGE—Lionel train, two reels of film, 180-ohm relay, Brownie camera, 110-volt motor and rheostat, ½ H. P. Would like any of the following: Audion, variable rotary condenser, headset. What have you? A. H. Dreesner, 89 Dorman St., New Haven, Conn.

FOR SALE—Rotary gap disc, $1.25; Electro wireless course book form, 50c.; Rex motor, 40c. Rudolph Wensko, 2146 W. 81st St., Cleveland, O.

LOOSE COUPLER—Tunes to 2,000 meters, woodwork solid oak, primary and secondary varied by switches, $6, express paid. Also a 1,000-meter loading coil, woodwork solid mahogany, $2.25, prepaid. W. H. Ritter, 2748 N. 22d St., Kansas City, Kan.

EXCHANGE—I. C. S. electric lighting course and first-class drawing outfit, complete. Want 2-inch spark coil, Tesla coil or other experimental or wireless goods. Edward Olson, R. No. 1, Mt. Vernon, Wash.

WOULD LIKE to exchange a 110-volt, three-speed direct-current General Electric fan, worth $15; a medical coil, $3.50; Knapp electric question board, $2.50; a $15 boy scout snare drum; $5 Erector building set. Would like wireless apparatus, or I prefer a large electric train and equipment. Arthur Vernier, 34 Beecher Ave., Detroit, Mich.

$6 takes inductive coupler in hard rubber cabinet, coupling and turns varied by knobs. Want two 43-plate variables. Francis Pray, 102 Heath St., Somerville, Mass.

SELL OR EXCHANGE—Thordarson step-down transformer, bargain, $3.25; Brandes 2,000-ohm phones, $3.50; loose coupler, 3,000 meters, $2; volt-ammeter, new, 90c.; Mesco beginner's outfit, 85c. Other wireless apparatus and electrical books for sale. E. Braatz, Lowellville, O.

FOR SALE at a bargain: Nichols Gem set, detector, single-slide coil, Electrose insulators, carbide lamp. Electro fixed variable condenser, transmitting wave-reducing condenser and four-strand antenium aerial wire; all practically new. Make me offers. John A. Irvin, Cannelton, Ind.

BARGAIN — Perfect four-miler, Bunnell one-inch coil, zinc gap, Gernsback interrupter, fuse block, Victor key, two-glass plate condenser, D. P. D. T. switch; all $5.50. Receiving 1,500 miles. Bornite and zincite detector, Bunnell 500-ohm receiver, three-slide tuner, two fixed condensers, three antenna insulators, switches and sundries; all $2.75. Money order or cash, either or both shipped. R. W. Howe, 1120 Amsterdam Ave., New York.

HAVE 8 H. P. gasoline engine complete, 4 H. P. Gray marine engine, complete, with salt water fittings, never uncrated or used, and other apparatus. Want audion, automatic pistol, transformer, camera, anything electrical or wireless, or cash. Make offers. Send stamp. Clyde P. DeLancey, Box 71, Hampton, N. H.

FOR SALE—Several numbers "Electrical Experimenter," "World's Advance," "Modern Mechanics," "Popular Electricity and Modern Mechanics," one Morgan's "Wireless Telegraph Construction for Amateurs" and three handbooks; all going cheap. H. Frankland, 517 W. 113th St., New York City.

Opportunity Exchange

YOU will probably find more opportunities and real bargains in these columns than anywhere else in the country. Most good things in life are hard to find and worth going after—these little ads illustrate that point; you alone will be the real loser if you don't take the time to scan through these columns.

Advertisements in this section 4c. a word for each insertion. Count 7 words per line.

Name and address must be included at the above rate. Cash should accompany all classified advertisements unless placed by an accredited advertising agency.

Ten per cent. discount for 6 issues, 20 per cent. discount for 12 issues from above rate. Objectionable or misleading advertisements not accepted.

Advertisements for the March issue should reach us not later than February 5th.

EXPERIMENTER PUBLISHING CO., INC., 233 Fulton Street, New York, N. Y.

BOOKS

WANTED—Cosmopolitan Magazine, August, 1900; also Current Literature Magazine, October, 1900. Box 110, Marrill, Neb.

OPERATORS—Just the thing when on a cruise. The Midget Bible, size of postage stamp; 250 pages and illustrations. Sample, 10c. Wonder Co., 416 E. 135th St., New York City.

WARNINGS

And Advice to Small Investors:

by Erardus Sagra, who tells how he avoids loss and succeeds in receiving large returns for the investment of comparatively small sums of money in honorable and safe enterprises. His valuable experience, for which he charges $1 (by money order or registered letter; no stamps accepted) will save you quite a little fortune if you have a little patience. Satisfaction guaranteed or money refunded. Erardus Sagra is also the author of "The Might of Truth," the price of which is $1 net; but temporarily it has been introduced at the nominal price of only 24c. This interesting book is FREE to all who order the above mentioned "Warnings and Advice to the Small Investor." Those who purchased this book already at the nominal price need not send more than 75c. (It will take from three to four days to fill your order.) Address M. T. Dept., Box 2034, Middle City Station, Philadelphia, Pa.

HAVE you seen a copy? Amateur Photographers' Weekly, $1 per year; weekly prize competitions; criticisms; print exchange; illustrated; many features. Three months' subscription, 25c. Amateur Photographers' Weekly, 915 Schofield Bldg., Cleveland, O.

MISCELLANEOUS

WANTED—Young electricians in every city and town to install thermostats. A chance to start in business. Beers Bros. Thermostat Co., 1166 Portland Ave., Rochester, N. Y.

EXPERIMENTAL electric locomotive built to order. Send drawing or write me for my design. C. S. Haines, 723 E. 27th St., Paterson, N. J.

MAKE your own dry batteries. Guaranteed instructions with Blue Print, 25c. prepaid. Dirigo Sales Co., Bath, Me.

FILMS developed free; send negative for sample print and particulars. New Lex Novelty Co., New Lexington, O.

THERE is but one Telegraph School that places all graduates direct in the railway telegraph service. It is Pelnars, Madison, Wis.

DRAWINGS made for inventors. Consulting Engineer, EE-3240 Seminary Ave., Chicago.

PATENT ATTORNEYS

JOHN M. McLACHLEN, attorney-at-law. Patent causes. Union Trust Bldg., Washington, D. C.

PATENTS SECURED or fee returned. Send sketch or model for free search and report. Latest complete patent book free. George P. Kimmel, 254 Barrister Bldg., Washington, D. C.

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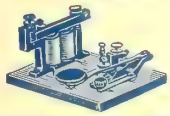
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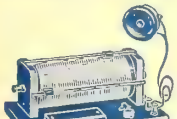
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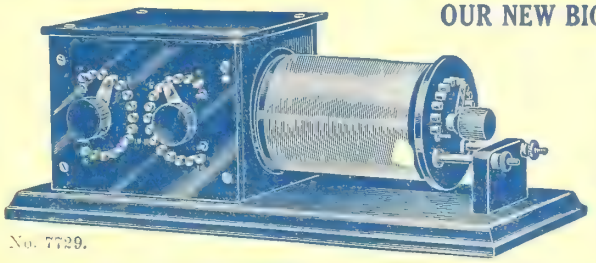
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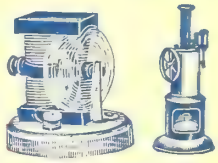
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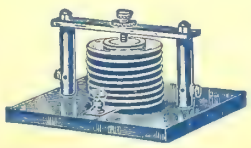
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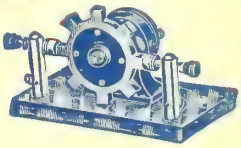
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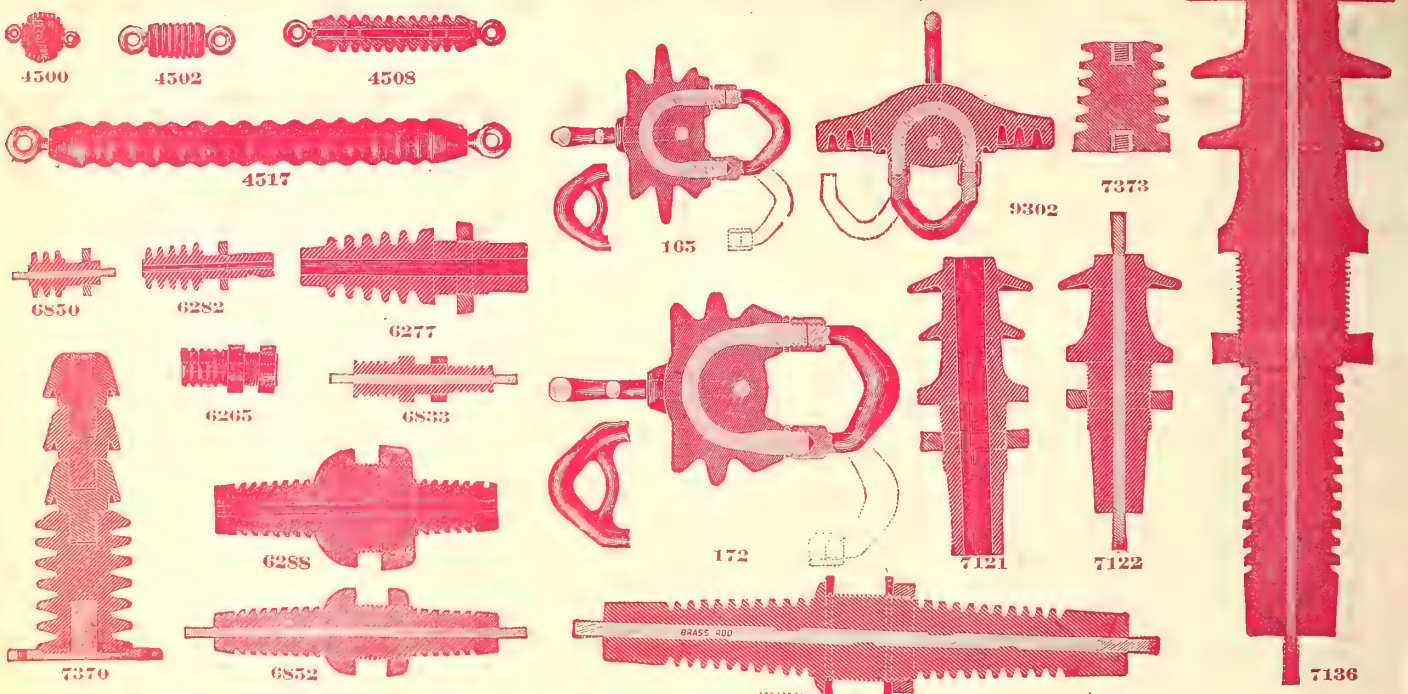
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"Superior" Set. Price $5.00 complete, including headband

will both vibrate when one of them is struck. This same principle has been applied to Brandes Wireless Receivers. By perfectly matching the tone of the two receivers, the weak sounds that you would otherwise lose, are brought out so as to be easily interpreted.

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They are very light and easily adjustable. No pinching or slipping. You set them to fit exactly; after that they're as easy on your head as your hat.

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We are in a position to furnish prompt shipment of the following sizes of switch points:

Tapped to take 6-32 screw.

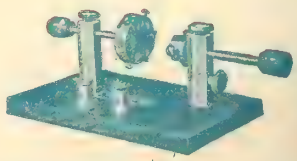
No.	Diam.	Height	Doz.	50	100
626	¼ inch	⅜ inch	$.30	$1.00	$1.75
628	¼ inch	¼ inch	.30	.90	1.50

With ½ inch shank threaded 6-32

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Nickel points 50 per cent. advance.
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The "Albany" Combination Detector



Lacquered brass.....$2.50
Polished nickel..... 3.00
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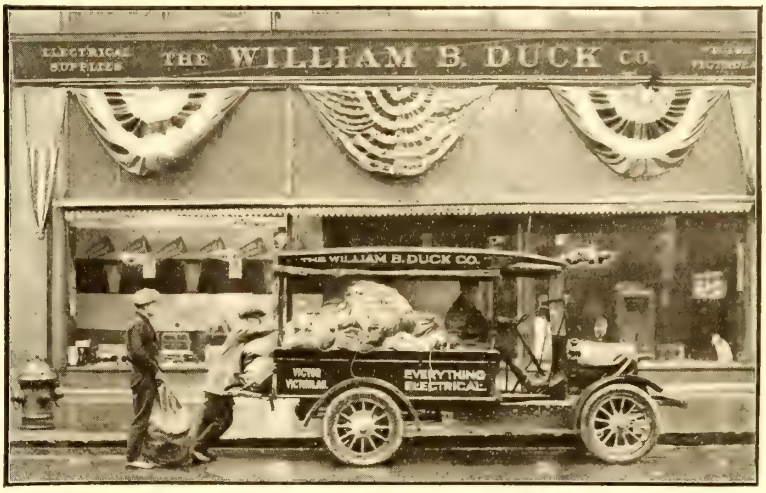
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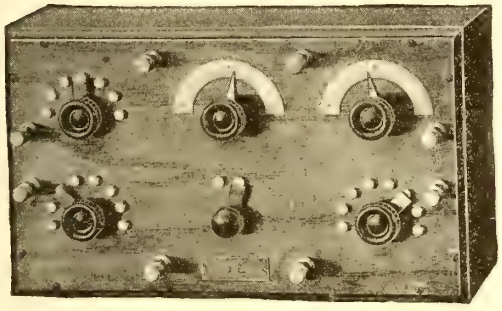
150 pp. Wireless Instruments, magnet wire of all kinds, raw material, storage batteries, telegraph instruments, battery motors, commercial motors and generators, sewing machine motors, telephones, step-down transformers, massage vibrators, bells, push buttons, auto accessories, flash lights, hand lanterns, auto and miniature lamps, Xmas tree outfits, voltmeters, ammeters, lighting plants, Victrolas, air rifles, electric aeroplanes, model builders, electric railways, electrical and mechanical books and general electrical supplies.

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A De Luxe Wireless Receiving Station

Wave Length 3,000 Meters On An Average Length Antenna



DE LUXE improved variometer a complete Station to receive N. A. A. Arlington, Va., N. A. R. Key West, Fla., W. S. T. Miami, Florida, capable of receiving all government or commercial Stations along the coast, and has a wave length of 3,000 meters on an average antenna.

The Station consists of variometer tuner working on entirely new principles, different from any heretofore offered. It consists of a primary and secondary loading inductance placed in non-inductive relation to each other. The Tapped Loading Inductance does the tuning by means of units and tens switches, which produce the most efficient tuning.

A Short wave variable condenser is placed in across with the antenna so as to enable you to work the amateurs at leisure, another variable is placed across the secondary by means of which the capacity of the secondary circuit is raised to a higher wave length. In this set is placed a new Instant Radiograph in place of a detector which will enable you to receive signals instantly at all times without loss of time or messages.

This Station is set into a mahogany finished cabinet and hard rubber top, complete with 2,000 Ohm Brandes Superior Head-set, at our lowest possible price, $20.00 for March. This outfit is well worth $50.00 to you.

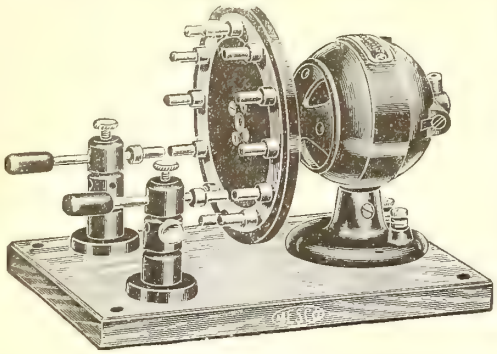
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Mesco Rotary Spark Gap

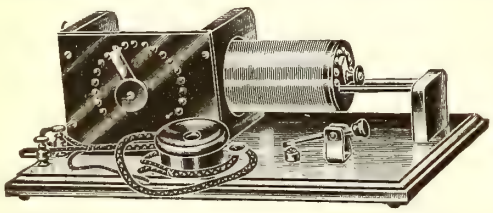
Emits a high musical note. Can be heard at greater distances than the note from the stationary type. Cannot be mistaken for static or other atmospheric disturbances. Produces pure wave of low damping decrement. Increases transmitting efficiency 20 to 30 per cent.

The rotating member has twelve sparking points mounted on a hard rubber disk and is carried on the motor shaft. Can be used on our spark coils or transformers up to 1 K. W. Has two stationary electrodes with special adjusting devices.

Our Globe Motor is used. Will operate on 110 A. C. or D. C. circuits; speed of 4,500 R.P.M. Also made with our Globe Battery Motor, which can be operated on a six-volt circuit.

List No.		Price.
222	Mesco Rotary Spark Gap, 6 volt	$12.00
223	Mesco Rotary Spark Gap, 110 v., A. C. or D. C.	13.00
216	Rotary Unit Only, with two Stationary Electrodes for 3/16 in. shaft	5.00

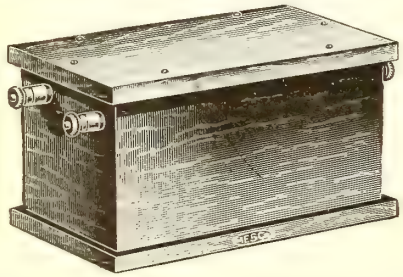
Manhattan Wireless Receiving Set



Consists of a loose coupler, fixed condenser detector, and an 80 ohm receiver with cord. Will tune up to 1,800 meter wave length on a 60-foot aerial. Can be tuned to waves over 4,000 meters with larger aerial and properly connected to loading inductance and variable condenser shunted across the secondary of the receiving transformer.

List No.		Price.
210	Manhattan Wireless Receiving Set	$10.00

Mesco Intensifying Transformer

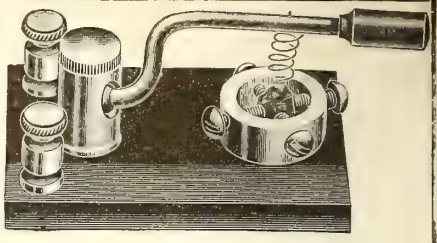


Used for intensifying signals received from any crystal detector by connecting an audion detector on the other side of the transformer winding. Used between two audion detectors, signals will be intensified 10 to 25 times.

As many as three of these transformers can be connected between audion detectors in cascade, forming an intensifier, making it possible to read signals not heard with any single known detector. Diagram of connections with full directions with each instrument.

List No.		Price.
224	Intensifying Transformer	$12.00

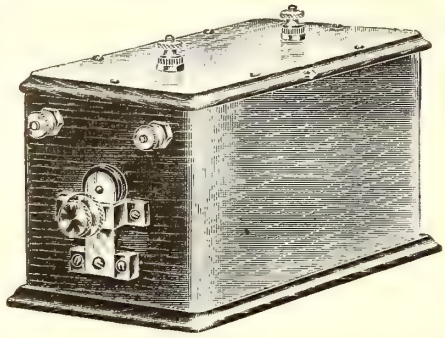
Mesco Universal Detector Stand



Has a heavy brass cup, with four binding screws; will hold crystals up to ¾ in. diameter. A hollow standard encloses a brass ball. Through an opening a brass arm with hard rubber handle is secured fast to the ball, making a ball and socket joint, allowing it to be adjusted at any angle or used in any position.

Hard rubber base 2¼x4¼x⅜ in. All metal parts nickel-plated. Remains permanently in adjustment under jars and vibrations of every description.

List No.		Price.
248	Mesco Universal Detector Stand	$3.00



Mesco Wireless Spark Coils

Have low current consumption. Best to operate on dry batteries. Contact points of heavy platinum iridium. Has primary condenser in case. Made for wireless work. Permits of close tuning. Spark at interrupter reduced to a minimum; spark is heavy; made in ¼-inch to 4-inch sizes. Our Manual gives all the technical points.

List No.		Price.
462	Spark Coil, 1 inch; can be operated on 6 Red Seal dry batteries	$5.40

Send 10c. for Copy of Our Wireless Manual No. 9

YOU GET YOUR MONEY BACK ON AN ORDER OF $1.00

It contains 120 pages and tells how to erect and maintain wireless telegraph stations. Shows a number of diagrams. Has the Morse and Continental Telegraph Codes. Illustrates the best instruments to use; tells what they are for and how to use them. Has many new diagrams and other valuable information not contained in any other book. Do not wait. Send your request now.

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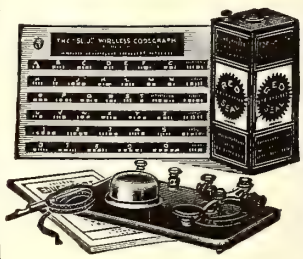
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Mesco Codegraph



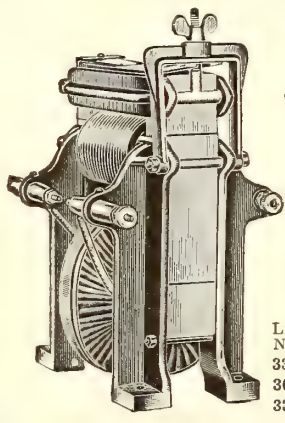
A dandy practice set for the beginner. Just the right kind for the apt boy.

The Codegraph Plate is of metal with insulated dots and dashes. The Pen is connected with the Red Seal Dry Battery and the Wireless Practice Set. When the pen is drawn across the dots and dashes it closes the circuit, and the buzzer sounds. It is possible to attach a sounder to the outfit and get the telegraph click also. A practical and efficient way of learning wireless and telegraph signals.

List No.		Price.
303	Mesco Codegraph Set	$2.50
304	Codegraph Plate, Pen and Book	1.00

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Mesco Flexible WIRELESS TRANSFORMERS

Will make wireless apparatus 200 per cent. more efficient. When short circuited or when charging condensers does not consume any more power than the magnetic shunt is set for. Can be connected direct to alternating circuit.

List No.	Capacity.	Secondary Voltage.	Price.
330	½ kw.	5,000 v.	$15
363	¾ kw.	10,000 v.	20
331	1 kw.	20,000 v.	25

Mesco Wireless Receivers

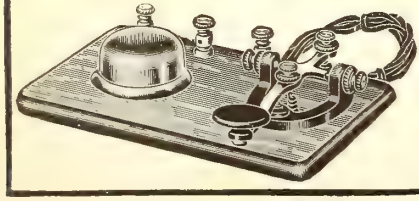


Have powerful field magnets and thin diaphragms, and are very sensitive. Our No. 480 Double Head sets complete have been used in receiving commercial wireless messages over distances of 2,000 miles. All receivers are wound with silk covered copper wire.

Best steel obtainable used in construction of the permanent magnets. Users have had head sets for five years and over without any deterioration in sensitiveness. This cannot be said of any light-weight receivers.

List No.		Price.
480	Double Head Band, with six-foot green silk cord and two receivers, 1000 ohms each	$6.00

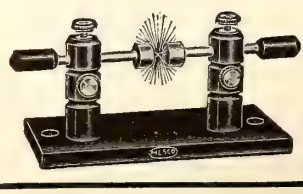
Mesco Wireless Practice Set



Comprises a regular telegraph key, without circuit breaker, a special high pitch buzzer, one cell Red Seal dry battery, and four feet of green silk-covered flexible cord. The main object of the set is to enable the beginner to master the wireless code, and the buzzer reproduces the sound of the signals of the most modern wireless stations perfectly.

List No.		Price.
342	Wireless Practice Set, with battery and cord	$1.88

Mesco High Efficiency Spark Gap



Adapted for stations up to ¼ K.W. capacity. Base is of polished hard rubber. Standards are of hard rubber composition of the highest insulating properties. Hard rubber ends on the brass rods permit the length of the gap to be varied, while sending. Spark terminals are of zinc, and are renewable.

List No.		Price.
465	High Efficiency Spark Gap	$2.80

The Electrical Experimenter

Published by Experimenter Publishing Company, Inc. (H. Gernsback, President; S. Gernsback, Treasurer; M. Hymes, Secretary), 233 Fulton St., New York

Vol. III Whole No. 35 **CONTENTS FOR MARCH, 1916** **No. 11**

FRONT COVER—"THE TESLA DESTROYER"..... From a painting by Thomas N. Wrenn.
THE UTILIZATION OF THE SUN'S ENERGY.....605-606
THE CHORALCELO, A WONDERFUL ELECTRIC PIANO..... 607
NEW USES FOR ELECTRICITY IN THE WAR..... 608
ELECTROCUTING SUPERFLUOUS CATS AND DOGS..... 609
KILLING THE SMOKE NUISANCE ELECTRICALLY..... By Samuel Cohen. 610
THE TESLA HIGH FREQUENCY OSCILLATOR..... By H. Winfield Secor, E.E. 614-615
ELECTRICITY WONDERFUL AID TO MODERN SURGERY.... 616
ELECTRICITY, THE BENEFICENT.....By Benjamin G. Lamme, Chief Engineer, Westinghouse Elec. & Mfg. Co. 619
MARVELS OF MODERN PHYSICS.....By Rogers D. Rusk. 623
BARON MUNCHHAUSEN'S NEW SCIENTIFIC ADVENTURES. By Hugo Gernsback. 624-625
NEW 500 WATT MILITARY RADIO PACK SET..... 628
THE EVOLUTION OF WIRELESS TELEGRAPHY.....630-631
THE RECEPTION OF LONG DAMPED AND UNDAMPED WAVES.....By Thomas Appleby. 632-637
LIST OF NEWLY LICENSED AMATEUR RADIO STATIONS... 634
THE USE AND CONSTRUCTION OF A DECREMETER..... By Milton B. Sleeper. 635-637
CONSTRUCTION OF AN ELECTRO-MAGIC SKULL..... By Homer Vanderbilt. 638

The Future of Wireless

AT the present state of the art, Wireless can be sub-divided into three classes:

1st. Wireless Telegraphy or Radiotelegraphy.
2nd. Wireless Telephony or Radiotelephony.
3rd. Wireless transmission of Power. The latter we may term as *Radiokinetics.*

As is well known, the first two are already in every-day use, all over the world. The third is as yet undeveloped, but already it looms large above the horizon.

Like all great things, Wireless has had its share of trials and tribulations. It takes time to develop an entirely new art. Moreover, Wireless received a black eye in its earliest infancy in this country. As will be recalled, a number of unscrupulous individuals unloaded millions of dollars of worthless stock on a credulous public, before the art had sufficiently advanced to make possible a successful commercial exploitation.

Practical commercial Wireless Telegraphy is not much older than ten years to-day. Commercial Radiotelephony has but made its appearance during the past one or two years, while Radiokinetics does not exist at all as yet.

But let us consider how the three classes of Wireless line up as far as their ultimate usefulness and commercial practicability are concerned. Let us look the problem square in the face and let us see what we shall find.

It is our opinion that a purely Wireless Telegraph Company can never reach such immense proportions as our wire telegraph companies. The reason is obvious. The wire telegraph companies are too well intrenched to be driven out of the field; it is quite certain that wireless telegraphy can no more hope to supersede wire telegraphy, than the telephone superseded the wire telegraph. Aside from this it seems hopeless for any one large central wireless plant to send out and receive within a single hour, 8,366 separate messages, as is the case for instance with one of the New York offices of the Western Union Telegraph Company. Wireless will probably never lend itself to such exploitation. Its greatest use will always be long distance transmission of intelligence, either over land or water or both, and between land and ship or vice versa, or between ships. This is its true field and here the wire companies cannot compete. This naturally limits its possibilities. Thus, while the future of Wireless telegraphy does not seem too rosy, we need not feel discouraged. The young man who embarks in radiotelegraphy to-day, will use it only as a stepping stone towards something infinitely greater. This was the exact case of E. N. Vail, the present head of the American Telephone and Telegraph Co., popularly known as the Telephone Trust. Vail was originally a telegraph man when he was called in by Bell and his associates; had he not known all about telegraphy he probably would not be the president of the huge corporation to-day.

This brings us to Radiotelephony. To us there does not seem one field in the entire electrical industry that is destined to a greater and speedier development than this one. We venture to say that within the next fifteen years, Radiotelephony will become one of the greatest electrical industries, for it supplies one of the predominating wants of the times.

The radiotelephone can be used by anyone, just as easily as the wire phone. To operate the instrument it is only necessary to take down the receiver and talk. But three months ago it was demonstrated that it is eminently practical to catch the wireless voice—on the wing as it were—and connect it with an existing wire telephone line. Vice versa, President Vail talked into a wire telephone at New York, where his voice was transmitted to Arlington; here it "took wings" and was wafted without wires to Honolulu, some 4,000 miles distant. This accomplishment more than anything else has opened the public's eyes.

We prophesy that in less than 15 years every automobile, whether pleasure or commercial, will carry its small radiophone outfit. Its occupants will thus be in constant touch with their homes or offices and vice versa, a convenience much needed to-day. Imagine the immense usefulness of such a device. Nor is this an idle dream. There is at least one company in existence to-day capable of filling an order to equip autos with radiophones having a 20 mile range. Nor will there be much confusion of voices becoming mixed up in transit; our tuning apparatus is becoming more accurate each day and it will be an easy matter to tune out unwanted voices. It will take considerable capital and a host of trained men to turn out enough radiophones to equip several million automobiles, aeroplanes, motor-boats, yachts, and large vessels, but it will be done nevertheless and soon at that. Every farmer will have his Wireless Telephone to talk with his neighbors. Every train will have its radiophone enabling passengers to talk to their homes or offices. The radiophone will link moving humanity with the stationary one, the same as the wire telephone linked humanity together before. To us there is nowhere a brighter future than in the vast possibilities of the Radiophone.

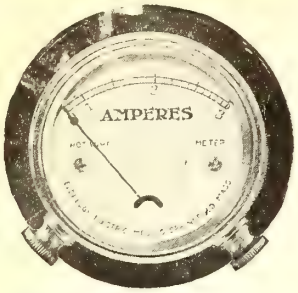
As to Radiokinetics, this will surely follow the Radiotelephone in due time. Its future is probably even brighter than the latter. Already Tesla speaks of transmitting energy by the thousands of horsepower wirelessly. Who dares predict what this branch of wireless will bring during the next twenty years?

H. GERNSBACK.

THE ELECTRICAL EXPERIMENTER is published on the 15th of each month at 233 Fulton Street, New York. There are 12 numbers per year. The subscription price is $1.00 a year in U. S. and possessions. Canada and foreign countries, $1.50 a year. U. S. coin as well as U. S. stamps accepted (no foreign coins or stamps). Single copies, 10 cents each. A sample copy will be sent gratis on request. Checks and money orders should be drawn to order of THE EXPERIMENTER PUBLISHING CO., INC. If you change your address notify us promptly, in order that copies are not miscarried or lost. *A green wrapper indicates expiration.*

All communications and contributions to this journal should be addressed to: Editor, THE ELECTRICAL EXPERIMENTER, 233 Fulton Street, New York. Unaccepted contributions cannot be returned unless full return postage has been included. ALL accepted contributions are paid for on publication. A special rate is paid for novel experiments; good photographs accompanying them are highly desirable.

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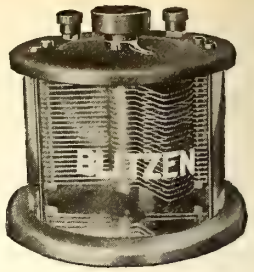


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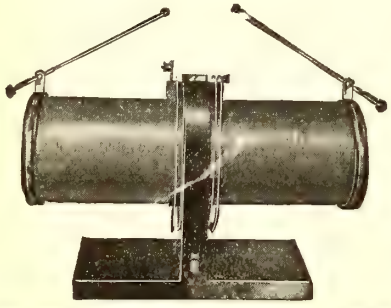
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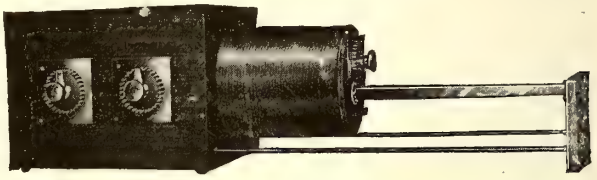
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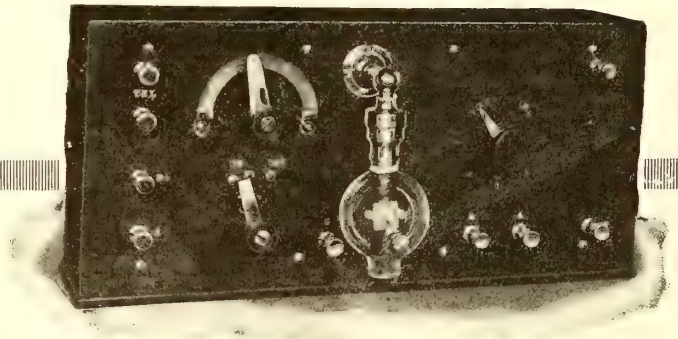
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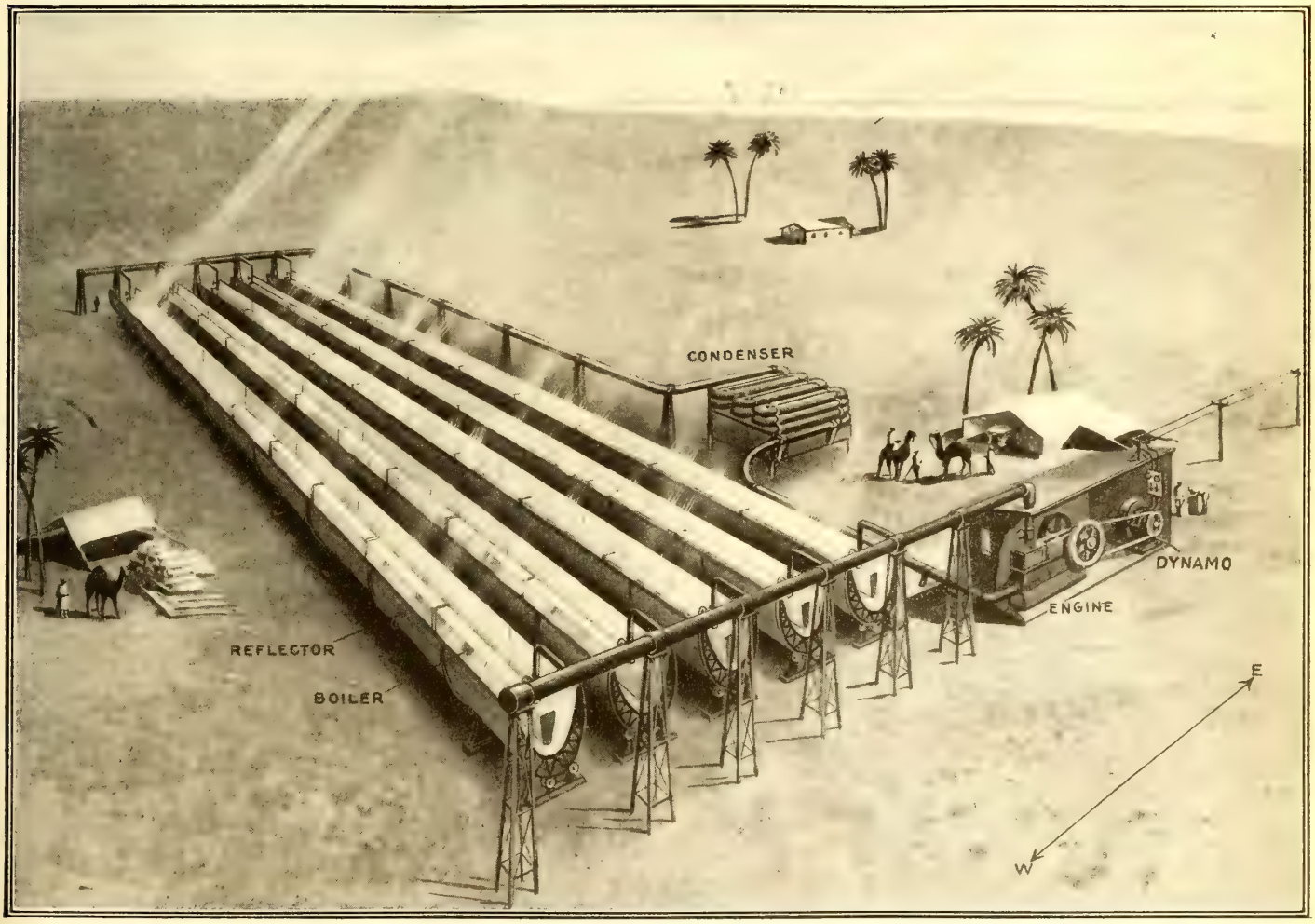
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Vol. III. Whole No. 35 MARCH, 1916 Number 11

The Utilization of the Sun's Energy

Years Ago Man Endeavored to Make Practical Use of the Energy Contained in the Sun's Rays—Even Tesla, the Electrical Wizard, Has Patented a Sun Motor, While the Shuman-Boy's Engine and Sun Boiler Has Developed 100 H. P. There Is Great Promise Held Forth to Future Engineers Who May Work on This Problem.

IT has been given to astrophysicists to measure the heat generated by the sun and calculate the force emanating from it. We know that the surface of our luminary gives out a heat estimated to be about 6,000° centigrade, and that its light equals that of 27,000,000,000 candlepower a quarter of a mile away. The heat which the earth receives from the sun in the course of a year would suffice to melt a belt of ice about 55 yards in thickness extending clear around the earth. Only the 2,735-millionth part of the total energy given off by the sun reaches our earth and, if this were lacking, our planet, with all its thousandfold life, its thick forests and fruitful plains, would turn into a dead, rigid ball of rock, for the average annual temperature, which is now one of 13° centigrade of warmth for Europe, would, without the heat of the sun, sink to 73° centigrade of frost, it is calculated.



A Successful 100 H.P. Sun Power Plant Located at Meadi, on the Nile, Egypt.

Every sort of light with which we illuminate our home when the greater light has sunk beneath the horizon, every fire that warms us when the solar rays can no longer do so, is a product originating in the sun. The chip of wood with which the untaught son of nature brightens his hut, the twigs with which he stokes his fire, what are they but pieces of trees that grew in the sunlight? The gas of the city dweller, the coals with which he heats his house and from which the gas has been sucked, what are they but transformed sunbeams? The coal in the grate is the petrified wood of perished forests that covered the earth's surface millions of years ago, and flourished in the rays of the same sun that ripens our corn to-day. Petroleum, that mysterious earth-oil, comes from the bodies of millions of dead and

gone animals, chiefly natives of the sea, which lived in the gray ages and fed on things growing in the sun. Alcohol is also a plant product, and the candle our ancestors took to be an ideal light, is won

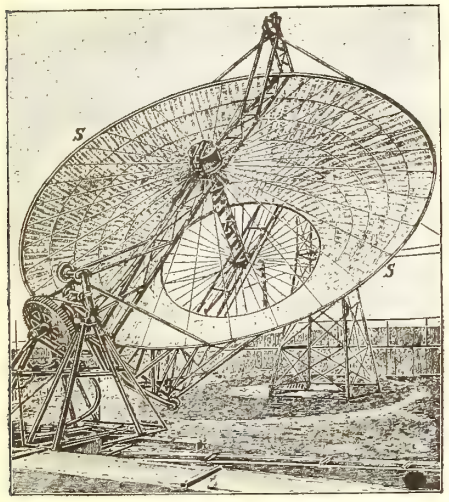


Fig. 1. Common Form of Sun Motor Adopted by Experimenters, Utilizing a Large Number of Mirrors and a Central Boiler.

from the animal and plant kingdom. The smoking fish oil lamps of the Eskimo are indirectly dependent on the sun for their fuel. And what of our own electric light? The dynamo developing the electricity is driven by steam, and the steam engine has to be fed with coal or with other materials gained from the animal and plant kingdoms. How about the waterfall? It would not exist if the sun did not suck up water from the earth's surface, and which is again deposited on the earth in the form of rain.

If it were rendered possible to use the sun's heat itself for the firing of furnaces an ideal state of affairs would be attained. There was a sun motor used for some time on an ostrich farm (see Fig. 1) in South Pasadena, Cal. This consisted of a concave mirror made of single glass planes set together, and measured about 12 yards in diameter. The sun's rays were collected and focussed on to a water tank, let into the mirror in the shape of a cylinder, 2½ yards long, which acted as its axis. When the water tank remained empty on a sunny day its walls grew red hot in less than an hour. The 400 quarts of water it contained was brought to the boiling point in 15 minutes and the steam developed drove a motor of 10 horsepower, which in turn worked a pulley raising 5,600 quarts of water per hour; a decidedly noteworthy performance.

The temperature of the sun, as aforementioned, has been calculated to be about 6,000 degrees centigrade. Several authorities point out that this terrific heat therefore precludes any possibility of the sun being a molten mass in the process of combustion. It has been thought recently by many to be a great mass of matter possessing to a remarkable degree radio-activity akin to radium. Helmholtz proposed that the sun could keep on producing energy at its present rate by accounting for same on the basis of a slight annual shrinkage in its size. From observations and measurements of this heavenly body made from year to year it has been computed that the age of the sun would, on the shrinkage basis, be 17,000,000 years.

The radiant energy received from the sun at the outer surface of the earth's atmosphere is equivalent to 7,300 horsepower per acre. Of this about 70 per cent. or, roughly speaking, 5,000 horsepower per acre, is transmitted through the atmosphere to the land surface proper of the earth, at noon on a clear day. Lesser amounts, of course, are received in the early morning and late afternoon, owing to the greater thickness through which the energy must pass.

Relative to the basis upon which solar energy is calculated for the earth's surface, this is generally made, it may be said, on the "solar constant," as it is termed, ascertained from 696 tests conducted by the Smithsonian Institute of Washington, in various parts of the world, which resulted in accepting 1.93 calories per square centimeter per minute, equal to 7.12 British thermal units per square foot per minute. This is an average value, all things considered.

Only about three-fifths of the solar radiation produce any impression on the earth, and it is only the radiant energy which falls on some material body that is converted into heat. The best body for this conversion having been ascertained to be a dead black one.

Many scientists and philosophers in the past century have tried various methods by which to concentrate the sun's rays, such as schemes utilizing an immense number of lenses built in the form of a huge cone, as previously described and illustrated at Fig. 1. A European experimenter in the year 1820 constructed one similar to this, but on a small scale. This model concentrated the rays sufficiently to melt tin at a distance of 68 yards from the apparatus, and also it was possible to cook food and melt silver instantaneously.

In the year 1882 a Frenchman by the name of M. Pifres devised a solar engine which was built on the roof of a building in Paris to drive a printing press, and the paper so published was called the "Soleil Journal." Capt. John Ericson experimented with solar engines from 1868 to 1886 with more or less success, but nothing remarkable or practical was developed. Another early worker was A. G. Eneas. His solar engines are described in United States patents issued in 1901, bearing the numbers 670,916 and 670,917.

Getting down to basic and simplified apparatus for utilizing such radiant energy as that possessed by the sun's rays, both visible and invisible, we may consider the apparatus of this nature devised by Dr. Nikola Tesla, the well-known electrical scientist. His United States patents on "Apparatus for the Utilization of Radiant Energy" bear the numbers 685,957 and 685,-958. This apparatus, intended to absorb and transform such radiant energy as that given forth by the sun, is shown in the illustration at Fig. 2.

Tesla says of this matter that his own experiments and observations have led him to the conclusion that such sources of radiant energy as the sun throws off with great velocity, minute particles of matter which are strongly electrified, and are, therefore, capable of charging an electrical conductor, or, if not so, may at any rate discharge an electrified conductor either by carrying off bodily its charge or otherwise. His patents in this direction are based on alleged discovery by him that when such rays or radiations are permitted to fall upon or impinge against an insulated conducting body P connected to one terminal of a condenser, such as C in Fig. 2, while the other terminal of the condenser is made by independent means to receive or carry away electricity, a current flows into the condenser so long as the insulated body P is exposed to such rays; so that an indefinite, yet measurable, accumulation of electrical energy in the condenser takes place.

This energy, after a suitable time interval, during which the rays are allowed to act in the manner aforementioned, may manifest itself in a powerful discharge, which may be utilized for the operation or control of a mechanical or electrical device consisting of an instrument R, to be operated and a circuit-controlling device d (Fig. 2-A).

Tesla bases his theory on the fact that the earth is negatively charged with electricity and he considers same to act as a vast reservoir of such a current. By the action of the sun's rays on the plate P there is an accumulation of electrical energy in the condenser C. A feeble current is supposed to flow continuously into the condenser and in a short time it is expected to become charged to a relatively high potential, *even to the point of rupturing the dielectric.* This accumulated charge can then, of course, be used to actuate any device desired.

An illustration of a proposed form of apparatus which may be used in carrying out his discovery is referred to in Fig. 2-B. In this figure, which in general arrangement of the elements is identical to Fig. 2-A, the device d is shown as composed of two very thin conducting plates, t t^1, placed in close proximity and very mobile, either by reason of extreme flexibility or owing to the character of their support. To improve their action they may be enclosed in a receptacle from which the air may be exhausted. The plates t t^1 are connected in series with a working circuit, including a suitable receiver, which in this case is shown as consisting of an electromagnet M, a movable armature a, a retractile spring b and a ratchet-wheel w, provided with a spring pawl r, which is pivoted to armature a, as illustrated. When the radiations of the sun or other radiant energy source fall upon plate P a current flows into the condenser, as before explained, until the potential therein rises sufficiently to attract and bring into contact the two plates t t, thereby closing the circuit connected to the two condenser terminals. This permits a flow of current which energizes the magnet M, causing it to draw down the armature a and impart

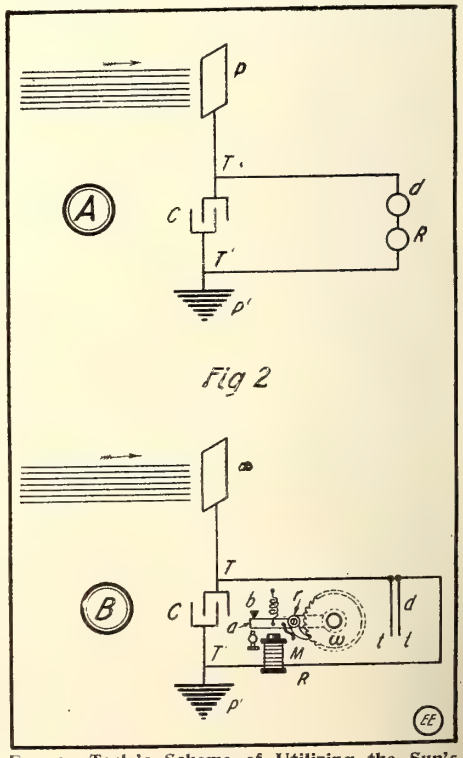


Fig. 2. Tesla's Scheme of Utilizing the Sun's Energy.

(*Continued on page* 662.)

The Choralcelo, a Wonderful Electric Piano

This Marvelous Electrically Operated and Controlled Musical Instrument Is More Than a Piano—It Produces Sustained Notes of the Lowest and Highest Register Over a Range Heretofore Unattainable, and, Moreover, Is Played Like a Regular Piano

IN India, far away, as the popular song goes, the natives are content to regale themselves musically with the plaintive notes given forth by a goat skin stretched over the end of a hollow log, upon which the musician beats a tune with the flat of his hand.

The music of the cavemen was the wind sighing through the trees, accompanied by the rustle of the leaves. Even they wanted to express themselves in a harmonious manner, hence the drum, the horn and other crude instruments of musical expression.

Then we may possibly expect some marked advances in our musical culture and education since the advent of he "Choralcelo," despite the prophecies of those who take a pessimistic view of life in general.

The piano becomes a tongue-tied infant beside this latest masterpiece of the musician's art. At times its notes thunder forth and seem to shake the very earth itself, and then again they may be subdued to an elusive softness like unto the faint notes of a distant church choir.

But what is it? How is it accomplished? What is the result of many years of untiring labor on the part of several of the cleverest men of the world? What is it on which a fortune that would ransom a king has been spent? The Choralcelo!

The Choralcelo, the most wonderful musical instrument ever thought out by the human mind, is like nothing else the world of music has ever known. This masterpiece reproduces any piece of music in any form of instrument, from a string to a flute; not only does it reproduce them, but the notes emitted by it are sustained, pure and sweet, which is entirely different from the ones produced by the instruments that are in present use.

Practically all the musical instruments, previous to the invention of the Choralcelo, carry into the tone which they produce certain impurities which arise from the manner in which they are caused to vibrate. The violin interrupts the free vibration of the string by the grating rub of the bow. The piano adds the noise that results from the blow of the hammer on the string—while the organ mingles the *breathiness* of its air current with the pure vibration of the column of air within the pipe. In like manner all instruments employing extraneous contacts to start the vibration destroy the purity of the note produced. And as they seek to amplify the tone that they have produced they increase the intrusion of extraneous and false sounds. The soft pedal of the piano, the swell-box of the organ, the mute of the violin, are just so many outrages on the purity of the tone.

The Choralcelo, by the very means which it employs in producing the tones, is freed from all obstructions. Vibration without contact, involving *perfect freedom of vibration,* and thus the Choralcelo gives all the natural overtones and harmonics; rich—full—pure and perfect, thus opening to the musician wonderful possibilities of expression and emotional power of which he possibly never dreamed.

The manner in which this result is accomplished is one of wonder. It is the subtle pull of the electro-magnet which now achieves pure tone production. These electro-magnets are caused to act directly upon the strings of the instrument.

The most delicate graduation of tone power can be produced by the mere variation of the strength of an electric current, and not by *smothering* devices which the present form of instrument employs. The tone, therefore, retains all its original purity through all vibrations and intensity, something which has been impossible heretofore.

We will next inspect the mechanism employed to perform these wonders. It may be stated that the vibrating elements are caused to oscillate by means of a pulsating electric current sent through an electro-magnet acting on the vibrating membrane. The machine which breaks up continually the electric current into a series of waves is really the "heart" of the Choralcelo. The operating device consists essentially of a series of metal discs having a certain number of insulating segments inserted in their peripheries. These discs are arranged to revolve at a fixed speed. Silver-tipped brushes are so placed that they will bear upon the revolving discs. It will thus be seen that in order to produce the fundamental periodicity of any given "string" it is only necessary to rotate a disc containing a certain number of segments at the correct speed.

A large variety of combinations are possible through the manipulation of a few keys, which correspond to the stops of an organ, and such a keyboard is clearly shown at Fig. 1. This resembles a piano, and it really is one, with additional keys and pedals. The pedals are used to vary the strength of the current sent through the electro-magnets.

A tremolo effect is given by means of a slow speed interrupter giving a pulsating current at a few revolutions per second. The instrument which produces this effect is depicted on the right of Fig. 2, while the one toward the left reproduces tones representing a flute. The regulation piano tone is produced with the usual percussion hammers, which may be thrown into or out of action by the pressure of a key. The staccato notes of the piano may be struck upon strings already vibrating with the pulsating current. Thus sustained notes of a higher pitch are produced upon the string. A piano which employs both the electro-magnets and hammers is clearly shown on the left of Fig. 3. Note the large number of wires which are employed for connecting the various magnet coils. It is an engineering feat in itself to even make and wire the various circuits.

Marvelously sweet tones are produced by vibrating pieces of brass, wood and aluminum. In fact, any resonant body susceptible to vibration may be made to emit tones. In order to cause these bodies to vibrate it is

(*Continued on page* 664.)

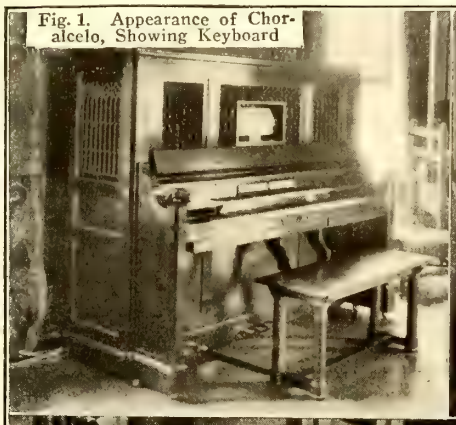


Fig. 1. Appearance of Choralcelo, Showing Keyboard



Fig. 3. Various "Chime" and "Flute" Attachments.



Fig. 2. Instrument for Producing Special Music.



Fig. 4. "Flute" Auxiliary Apparatus having great range.

New Uses for Electricity in the War

MICROPHONE NOW DETECTS MINE SAPPERS.

Electricity has been utilized to an unimaginable extent in the present titanic struggle across the ocean. In the interesting illustration shown herewith we see one of the latest adaptations of this wonderful agent of man and involving the microphone. The microphone, the electrical instrument which will pick up a delicate sound and transmit it in the form of undulating electric currents over a circuit, has solved many an important problem in the past, and especially during the present war.



How French Mine Sappers Utilize the Microphone to Hear the Germans Counter-Mining by Sound Conduction Through the Earth.

The two men at the right of the illustration are seen in the act of listening for German mine "sappers," and the men here shown are French. They, as you will note, are wearing shrapnel-proof metal helmets. A small box contains the batteries, etc., and the soldier leaning forward and listening so intently has in his hand a small but delicate watch case telephone receiver which is connected with the wires running along the wall to a supersensitive microphone placed in contact with the earth wall of this underground passageway. The French sappers are running a counter-mine out of the entrance of which one of the men is looking, as perceived at the right of the illustration.

It is indeed remarkable to what distances such sounds as those produced by pickaxes and shovels can be propagated through the soil. The sound conduction is also enhanced wherever rock or mineral formations are present to any extent in the earth. While the opposing sappers may explode their mine and blow up the French soldiers here observed resting so contentedly in the act of writing letters home, there is some consolation in knowing that they have a fair chance to climb out of the underground passage before the German mine has been driven far enough to do any damage, thanks to electricity.

TO BUILD NEW MARCONI TOWER AT CAPE MAY, N. J.

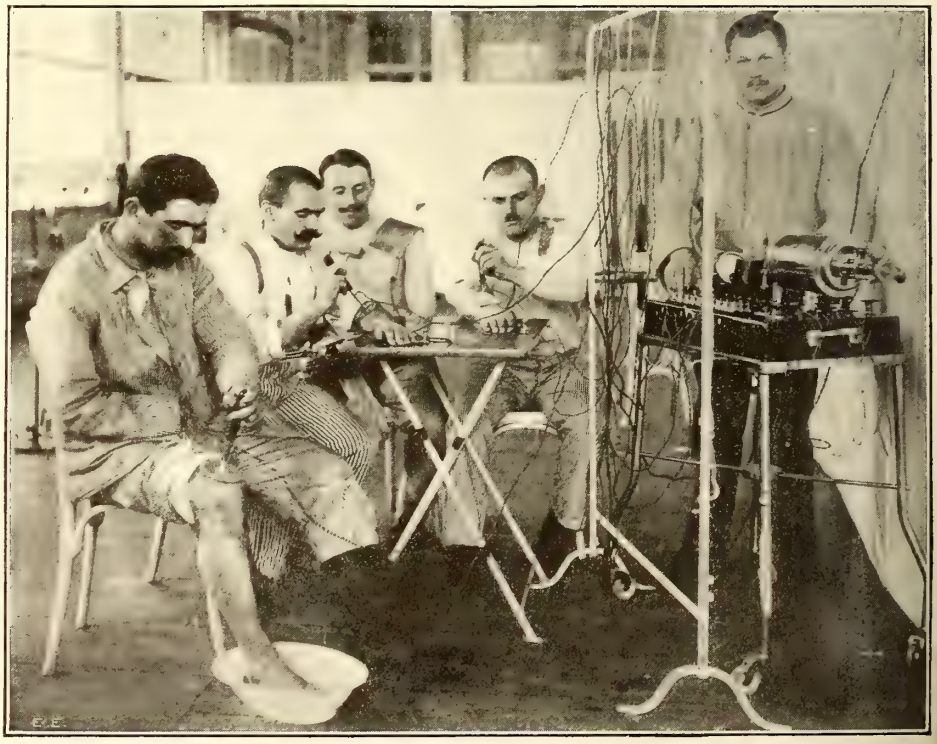
Sherman Sharp, a contractor of Cape May, N. J., has been awarded the contract to build the new building for the Marconi Wireless Telegraph Co. at Cape May. The building will be located about a half mile back from the shore on the site of the city water works.

The City Commissioners have leased the property to the Marconi company for 10 years, and the operation of erecting a tower 140 feet high will be started immediately.

HOW ELECTRICTY AIDS GERMAN SOLDIERS TO GET WELL.

The rigors of a hard winter in the trenches, besides the stiffness and other muscular complications resulting from bullet and shell wounds, are bound to show up in the sturdiest soldier sooner or later. Another important factor to be reckoned with in modern warfare is the tremendous nervous strain under which the men labor during or even before the actual fighting, owing to the heavy cannon and gun fire, as well as that of the machine guns, etc., which results in nervous exhaustion, and indeed in some cases in complete collapse.

In this event the soldiers so affected are invariably sent to the rear or to the nearest field hospital, if properly equipped for treatment of this kind. In the illustration herewith a number of convalescent German soldiers are observed taking treatment from a specially designed electro-therapeutic machine, supplying current of a certain frequency and strength. The current produced by this particular machine may be so regulated, when desired by the operator in charge, that it will have the characteristics of the well-known Faradic current, used extensively in the treatment of rheumatism and like complaints. Again the current may be specially controlled and regulated to the proper frequency and wave form adapted especially for the treatment of nervous exhaustion previously mentioned, which ailment, by the way, has been more noticeable in the present war than in any previous conflict.



Medem Photo Service

German Soldiers Undergoing Electrical Treatment for Stiffened Muscles, Nervousness and Other Ailments.

AGING WINE BY ELECTRICITY.

A method of "aging" raw wines and spirits by electricity has been perfected by Professor Charles Henry of the University of Paris (the Sorbonne), and it is already being successfully used in some of the Burgundy wine districts. The process is said to impart to liquors the same properties which they acquire by being kept for a number of years in cellars. The spirit or wine is placed in a special receptacle fitted with two tubes called "purgers," and the tubes are charged with high tension electricity at from 60,000 to 120,000 volts. The result is that all the bacteria, ferments and impurities collect in the tubes and are removed and all further ferment tion is stopped. The process is very rapid, and the cost is less than two cents per hundred gallons. Similar experiments are now being made with beer and essential oils.

Electrocuting Superfluous Cats and Dogs

WHEN your favorite Tabby or Fido strays away or is turned out for good you would like, doubtlessly, to see it killed as humanely as possible, if that is to be its end; and killed all such animals invariably must be, especially in large cities, where the total number of unclaimed pets gathered up by the authorities is truly astonishing.

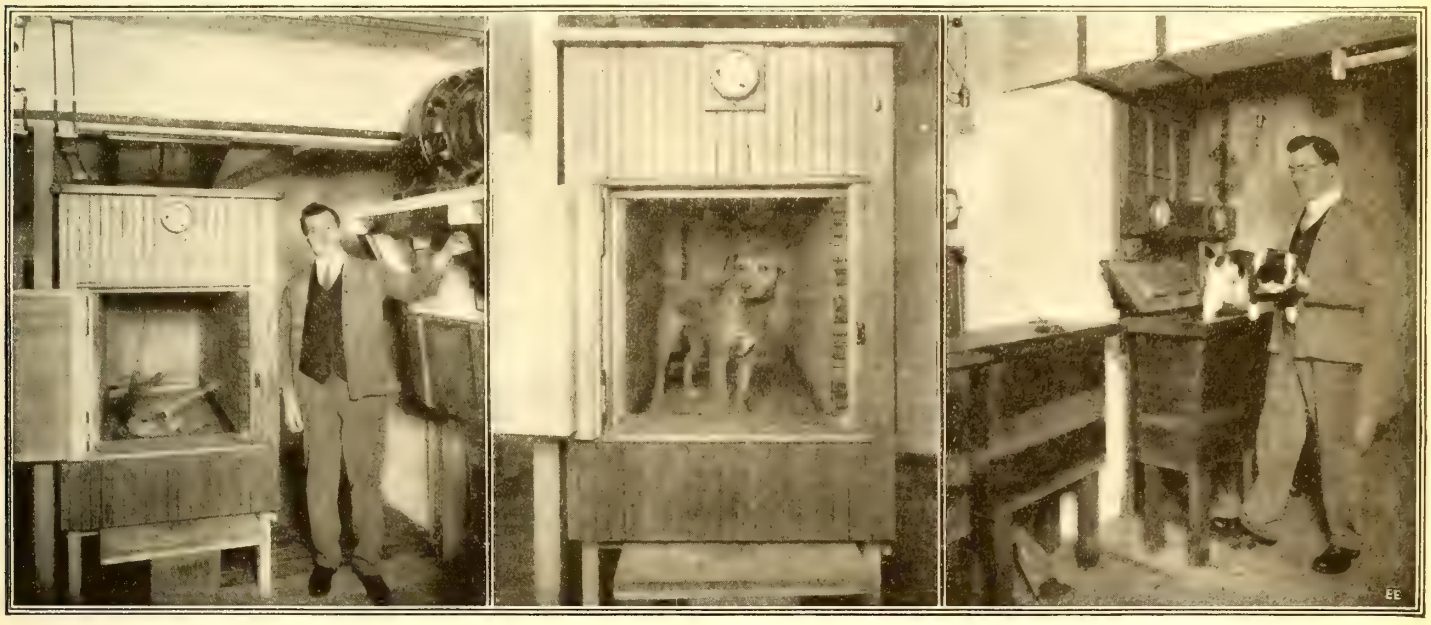
Electrocution, now widely adopted in various State prisons, has been happily incorporated in the latest apparatus employed by the Animal Rescue League of Boston, Mass. The illustrations here shown and reproduced through the courtesy of Huntington Smith, director of the above association, depict the electrical apparatus used for rapidly and painlessly killing such unlucky quadrupeds. Besides the apparatus installed in Boston for this purpose, there have been similar outfits adopted by over twenty other cities, which in the past five years have helped to destroy an unbelievable number of such animals.

In the year prior to 1915 there were destroyed no less than 480,848 small animals by 252 humane societies and their agents. In the past and, of course, to a very large extent at the present time there are several different methods employed for disposing of superfluous animals of different kinds, but mostly cats and dogs which are turned out of homes when people move away, etc. Among these methods are those involving the use of poison, chloroform, carbon monoxide, illuminating gas and shooting. None of these methods is in any way as humane as the new electrical method for exterminating such animals. The electrocuting outfit was first installed in the Animal Rescue League of Boston in 1911. It possesses all the best features recommended by those in charge of this kind of work, besides being highly recommended and advocated by many members of the medical profession who have looked into the subject deeply and who believe that life is cut off before any pain can be felt.

In the illustrations herewith we perceive (the center photo) how a dog is placed in one of the electrocution chambers. This cabinet measures about 2 feet 6 inches wide by 6 feet long and stands 4 feet 6 inches high. It is so mounted that it is at all times convenient for the operator to place the animal in the chamber. A metal pan is placed in the electrically insulated inner cabinet, while above it is fastened at either side; there is mounted a metal bar from which is suspended a strong spiral spring fitted with snap hooks at the free end. The lower electrode or pan is joined to one pole of a high-tension transformer, and the metal rod carrying the spiral spring electrode to the other high-tension pole. When the door of the cabinet is open the transformer primary is automatically opened also, to protect the electrocutioner; but when the door is closed the primary circuit of the transformer is completed. A flexible metal collar fitted with suitable electrode points is placed around the dog's neck and the spiral connection is hooked up to the collar. This stage of the electrocution is seen in the center illustration, with the animal alive, standing in the metal pan. In a second's time the door is closed and the dog receives the full strength of the electric current, which is believed from careful observations to kill him instantly, so that no pain whatever or torture is experienced. The illustration at the left of the group depicts the dog after electrocution.

In the illustration at the right the electrocutioner is seen holding the remains of an extinct feline. The apparatus for doing away with cats electrically is fitted up with metal electrodes hung at either end of a slate tray. The top of the cabinet automatically operates the transformer circuits, as in the case of the machine previously described. The cover is rigged up with a foot treadle so that by the pressure of the foot the top may be opened or closed, thus leaving both hands free with which to manage the animal, for, as most of us know, it requires some skill and agility to put a cat in a box or bag. The cat is grasped firmly with both hands and is then placed in the box or cabinet so that its fore feet rest on one electrode, while the hind feet rest on the other. The instant the cover is closed the high voltage is passed through the body of the cat and it is rendered unconscious or dead instantaneously. Peculiarly enough, it has been ascertained that cats require about twice the length of time necessary to electrocute dogs. Contrary to the reader's probable impression, this is not believed to be due to the proverbial nine lives accredited to the feline, but to its inherent vitality, to its higher organic resistance to the electric current and also to variations in the contact made, depending on the dryness of the skin.

A most interesting fact in connection with the electrocution of these animals is that the current when first switched on rapidly reaches a maximum and then falls off to about one-half of this value. The voltage employed for this work varies from 4,000 to 5,000. It is believed that a much lower potential will do the work in a satisfactory manner, but so far such tests have not been made, due mainly to humanitarian reasons. One kilowatt-hour of electrical energy will suffice to kill from 800 to 1,000 animals, it is said. An alternating current has also been found to be the best for this work.



Electrocuting Cats and Dogs at the Animal Rescue League, Boston, Mass. The Most Humane Way in Which to Kill Superfluous Pets.

ELECTRIC LAMP THE BEST READING LIGHT.

Recent scientific investigation has shown that the reading lamp which is equipped with the proper electric incandescent light and shade is superior to any other form of lamp for reading purposes. The essential features of this lamp are that the incandescent bulb is all frosted and that the shade is so arranged as to protect the eye from the direct light of the bulb.

One occasionally hears a preference expressed for the kerosene lamp for reading purposes, the statement usually being made that it is easier on the eyes. This is doubtless due partly to force of habit and partly to experience with unsuitable electric lamps.

The brilliancy of the incandescent lamp can be reduced to approximate that of the oil lamp by using an all-frosted bulb. By using a suitable shade the eyes will be still further protected and the light directed onto the book or paper which is to be read and a pleasing color tone may be obtained. The light from the oil lamp is made up principally of yellow, orange and red light, while the incandescent lamp gives much more nearly white light from which by means of proper shades any color can be obtained.

Proper lighting for reading purposes is a big factor in the general health of persons, since eye-strain reacts on the body, causing headaches, nervousness and indigestion.

Killing the Smoke Nuisance Electrically

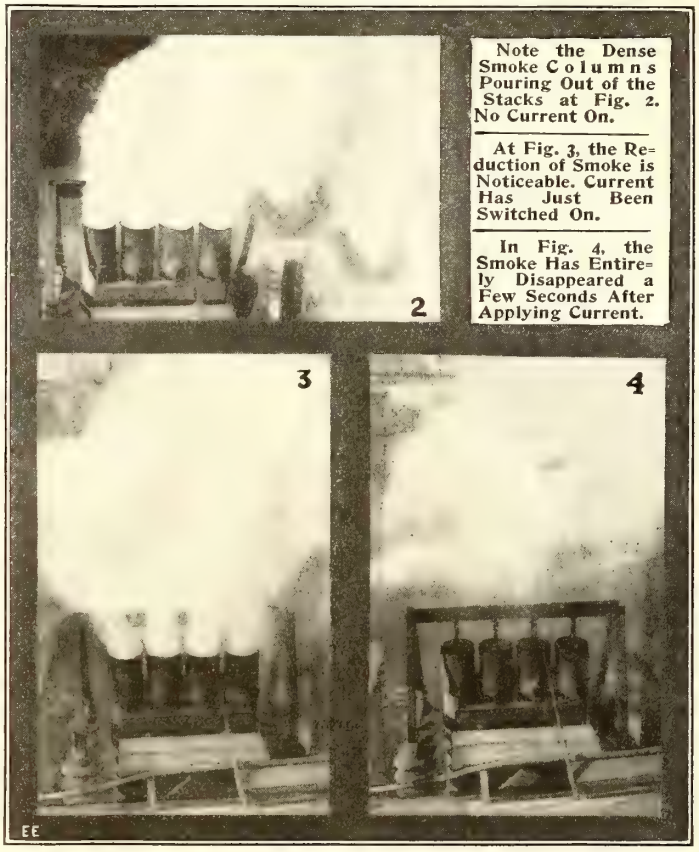
By Samuel Cohen

WE watch the smoke floating upwards from the chimneys of our manufacturing plants with thoughts that differ with the individual. The housewife thinks only of the damage done to her freshly washed clothes. The engineer thinks of the inefficiency of the plant, while the good citizen thinks of the effect such smoke will have on the health of the community. We will not enter into a discussion here as to which one takes the proper or best view, for it is well known that a pure and clear atmosphere is necessary for the health and welfare of a community.

The smoke nuisance has been made the subject of laws in many cities, but the manufacturer was at a disadvantage. No practical or reliable smoke prevention method was within his reach until recently, so that he had to rely on special grates, the use of hard coal or else on expert firing to prevent the levying of fines.

Leading engineers and scientists of this country and abroad have been constantly laboring on this problem, and although some of them have invented schemes for preventing the unnecessary smoke from entering the atmosphere from the stack, yet these were not of commercial value on account of being too complicated. The electrical precipitating method, however, has proved far superior to any other in its operation. The operation of this scheme is described herewith.

The electrical precipitation apparatus was originally devised by Sir Oliver Lodge, but it was finally developed and perfected by The Research Corporation, under the direction of Dr. F. G. Cottrell, the inventor of the present form of this apparatus. Since smoke is nothing more or less than minute particles of carbon and other solids suspended in the air the basic principle of his scheme for precipitating smoke, dust and mist is to charge all the particles in the stack with electricity. In this way they will be collected on the side of the conductor, and as soon as a large quantity of the soot is accumulated, it falls down to the bottom of the stack. A schematic diagram showing the connection of the various apparatus used is depicted in Fig. 1. It will be observed that a transformer is employed for supplying the high tension current. The voltage required depends upon the size and condition of the plant in which the apparatus is to be installed, so they vary from 50,000 to 100,000 volts. The secondary of the transformer is connected to a special rectifier which virtually consists of a rotating arm of four poles connected as perceived in diagram. This arm is revolved at constant speed by a synchronous a.c. motor. One of the stationary terminals is connected to a wire suspended in the stack and properly insulated from it by a high tension insulator. The opposite terminal from the stack is connected to the ground, which consists of a large number of pipes placed in the base of the chimney, while the other two terminals are interlocked with the secondary of the transformer. This rectifier is used to change the high tension alternating current to direct current, which is of extreme importance, as the whole secret of this type of apparatus lies in charging the particles with one kind of charge, so that they may adhere to one of the terminals and are thus prevented from escaping out of the stack. If an alternating current supply is not available, a motor-generator set is employed and the rectifier revolving disk is then placed on its shaft.



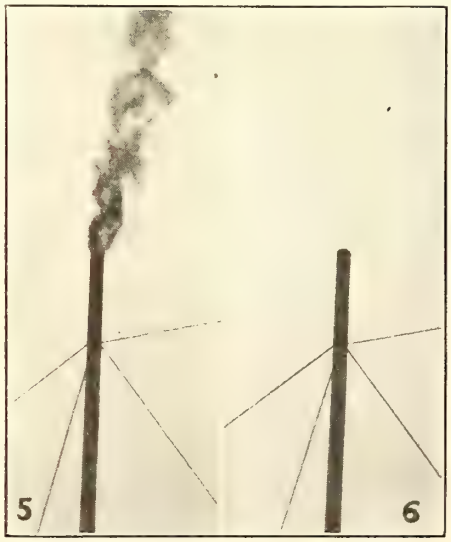
Several interesting illustrations are herewith given showing stacks fitted with this apparatus for eliminating smoke electrically. Fig. 2 illustrates such a stack when the current was turned off; note the density of the smoke cloud rising from it. As soon as the current was switched on, the smoke was reduced (see Fig. 3), and a few seconds later it had entirely disappeared, as shown by Fig. 4. Two other striking illustrations which show the marvelous efficiency of this apparatus are portrayed in Figs. 5 and 6; the former depicts the dense smoke issuing from the chimney, while the latter illustrates the appearance of the flue when the current was turned on.

Although the above mentioned apparatus is being extensively employed in the precipitation of smoke, it has also been used

(*Continued on page 669.*)



Fig. 7. A Laboratory Demonstration of Smoke or Vapor Elimination Electrically. Compare with Fig. 8 at Right.



The Smoke Nuisance Eliminated. Compare Fig. 5 (no current on) with Fig. 6, Where High Tension Electric Current Has Been Applied to Interior of Stack.

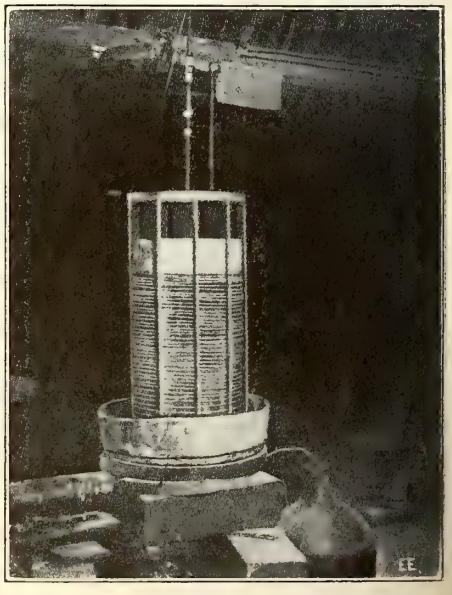


Fig. 8. The Vapor Cloud Has Vanished a Few Seconds After Applying the Electric Current. Compare with Fig. 7 at Left.

ELECTRICITY ON OCEAN LINERS.

The amount and variety of electrical apparatus carried by any large ocean liner is quite astounding. From the wireless aerial suspended high above the upper deck to the cargo lamps in the lowest hold electricity is in constant use.

The usual electric installation on a large liner consists of four engines and dynamos, each dynamo having a capacity of 400 kw. at 400 volts. There are also auxiliary generating sets, consisting of two 30-kw. engines and dynamos situated on a platform in the turbine engine room 20 feet above the water line. These auxiliary emergency sets are connected to the boilers by means of a separate steam pipe, so that should the main sets be temporarily out of action they can provide current for such lights and power appliances as would be required in the event of emergency. Working in conjunction with these emergency sets is a battery with a capacity of 3,500 ampere-hours, situated on the promenade deck, forward of the first-class smokeroom.

The electric lighting on such a steamer is equal to that of a good-sized town, the total number of incandescent lights being about 11,000, ranging from 8 to 16 candle-power. There are special dimming lamps in the first-class rooms, and the electric bell system includes 1,700 bell pushes and 29 indicator boards distributed all over the vessel, with fire alarm pushes distributed throughout the great liner and an alarm bell and indicator in the chart room.

There are electric heating, power and mechanical ventilation apparatus in service, altogether 188 motors and 600 electric heaters being installed throughout. The system of ventilation consists of electrically-driven fans—some suction, others pressure, and in many cases provided with steam coils for warming the air. Loud-speaking telephones of navy pattern are fitted for communication between the wheel house on the bridge and forecastle and after docking-bridge, engine room and wireless room, and also in the chief engineer's cabin.

The telephones are operated both from the ship's lighting circuit, through a motor generator, and alternatively by a stand-by storage battery, which is introduced in the circuit, should the main supply fail, by means of an automatic switch. There is also a separate telephone system for intercommunication between a number of the chief officials and service rooms, through a 50-line exchange switchboard. A number of the pantries and galleys are also in direct telephonic communication.

The apparatus for wireless telegraphy consists of a 5-kw. motor-generator. The house for the instruments is situated on the boat deck. There are four parallel aerial wires extending between the masts fastened to light booms; from the aerials connecting wires are led to the instruments

(*Continued on page* 655.)

What All the Electric Plants in America Could Do

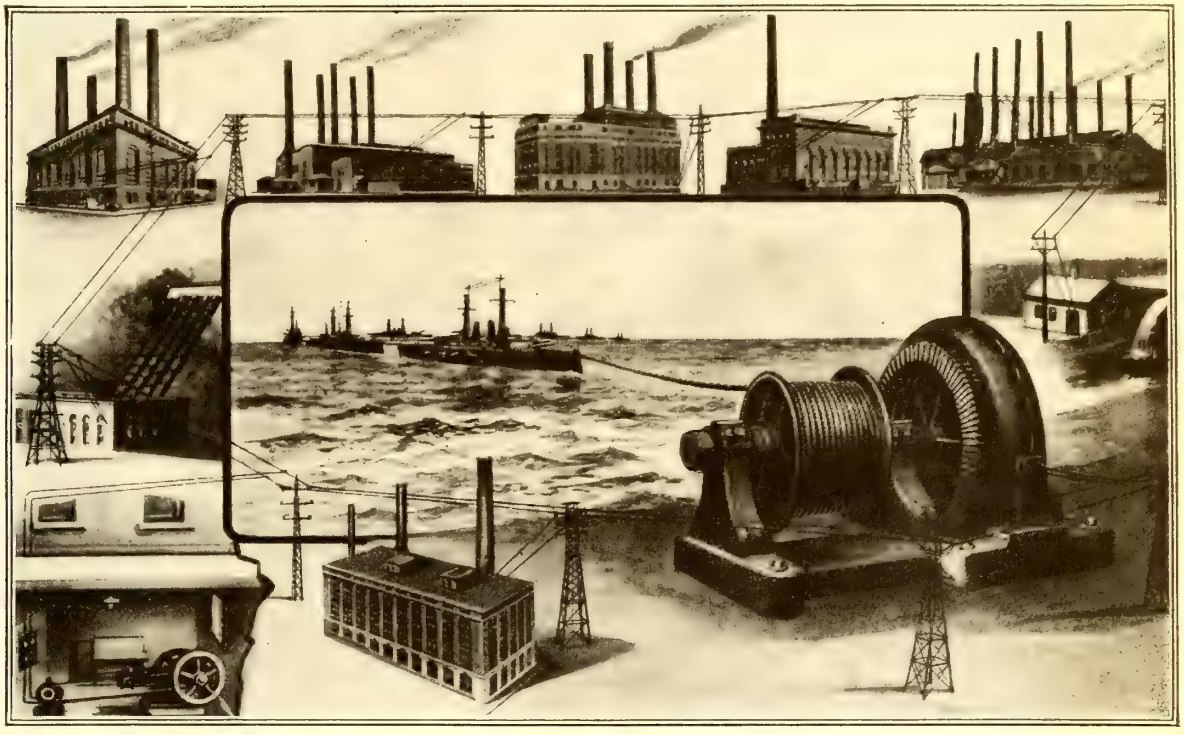
IT was after Watt's wonderful discovery of the power of steam, resultant from observing a tea kettle, it is said, and later terminated in the invention of his steam engine, that people realized its great energy producing possibilities. They then began to build Watt steam engines and used them advantageously for driving their machines. Although this source of power has rapidly increased in use the introduction of the generation of electricity, the internal combustion engine and modern water power developments have revolutionized power plant design and made practical the small, isolated plant. To-day electricity is invariably used in manufacturing plants for light and power, which, in those requiring a large amount of energy, is usually generated by steam driven generators, while gas is used in some of the larger plants.

One cannot conceive of the vast amount of electrical energy that is daily being generated throughout the United States. The following comparisons will serve to make somewhat clearer the great magnitude of the energy developed by all the plants in this country, including those driven by water, wind, etc. If these were connected in a single, continuous circuit with its terminals linked to some device, as a motor or electric lamps, we could then readily observe the effect of this tremendous power.

One of the simplest electrical devices known to the average person is the incandescent electric lamp. If we could obtain a sufficient number of these lamps of the 20-watt size, and string them along a wire line from *the earth to the moon*, the lamps being 15 inches apart, the amount of current necessary to light them would then represent the amount of power generated by all the dynamos in the United States, which in their entirety have an output of about 20,350,000,000 watts per hour.

For another illustration we might stretch a line of two conductors 15 *times around the earth* and place on this 1,000-watt lamps one hundred feet apart. The power required to light this gigantic line would also represent the electrical energy produced by these ever-humming dynamos.

An interesting comparison showing still another effect of this tremendous electrical energy is noted herewith. A fleet *thirteen times larger* than Uncle Sam's navy could be hauled through the water by means of a massive electric motor stationed at some fixed point. The power would have to be supplied from the generators through extremely large conductors, of course, in order to withstand the enormous electric current. The motor would also be of a special design, and of truly gigantic size in order to develop 27,614,766 horsepower. The only difficulties that would probably interfere with such an enterprise would be in obtaining or building transmission line, the motor and a proper foundation. This latter would have to be very strongly built to withstand the torsion when the motor started to haul the vessels.



The Total Electric Power Developed by United States Electric Plants Could Haul a Fleet Thirteen Times Larger Than Uncle Sam's Navy.

Again, if 20,350,000 1,000-watt lamps were connected to a common circuit and grouped in such a manner as to cause their total light to fall upon a concave reflector the total candle power of the light produced by this lamp bank would be about 18,498,150,000, which is enormous, of course, in comparison with the largest lighting displays with which we are ordinarily familiar.

A simpler lighting arrangement than the one before mentioned might be obtained by using two proper sized carbon electrodes, connected to some source of current and operating them as an ordinary arc lamp. The light evolved would be of such magnitude that it would be detected for several hundred miles, of course, but the curvature of the earth is not taken into account in stating this distance. The heat produced by such a scheme would be so terrific that anything known to man would be boiled.

This vast sum of energy is nearly inconceivable.

The "Nokolyd" Motor Car Rear Signal

Our readers will find it worth while looking into the merits of this automobile rear signal, as it is one of the most ingenious of all the automobile devices tested by the Safety First Society.

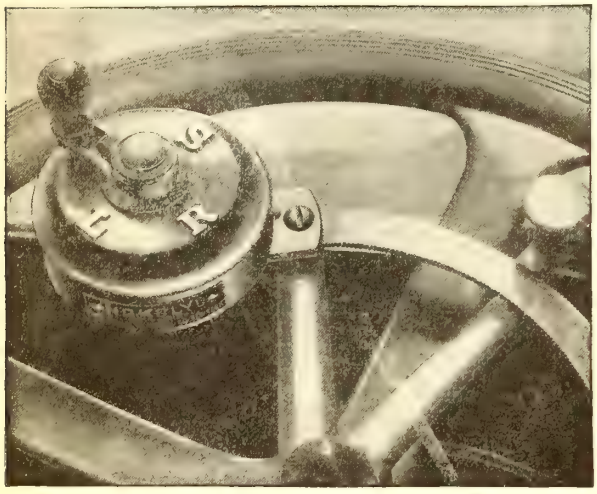


Fig. 1. Control Handle for Operating "Rear" Auto Signal.

The device is electrical. It is operated from the storage battery, which forms part of the equipment of every automobile, or it may be operated by ordinary dry cells. As each signal is set the current is automatically cut off, from which it becomes apparent that the current consumption is very low.

The controlling mechanism (Fig. 1) is fastened to the steering wheel, and within is an automatic stop mechanism which operates in a similar manner to a Postal Telegraph call box. The dust-proof box at the rear has a square member inside with four faces marked "stop," "right," "left" and the fourth space is plain white and shows when the controller is in a neutral position.

When the controlling lever is turned to the letters "S," "R," "L," or "O," the square member in the rear is turned by an electric magnetic device until the face "stop," "right," "left," or blank, corresponds to the letters on the controller. The controller can be turned one complete revolution without stopping at the intermediate letters, and the square member will also turn one complete revolution (Fig. 2).



Fig. 2. How New Auto "Rear" Signal Appears.

The "stop" signal shows white letters on a red background; the "right" signal shows black letters on an orange background; the "left" signal shows white letters on a green background. Both the "right" and the "left" signals are supplemented by arrows showing the direction. By day the signal is plainly visible for a long distance and by night it is automatically illuminated. A tiny bell rings when the signal is given, which informs the operator that the instrument has registered correctly.

FIREMEN AND ELECTRIC POWER LINES.

The slight danger that firemen run through the electric current passing from heavily charged wires along the stream of water they are squirting is proved by an experiment conducted by Ugo Tartaglini and reported in *La Scienzu per Tutti*.

A trolley car wire charged with a direct current of 525 volts had one end grounded; on the other end he directed a stream from a hose with a nozzle 15 millimeters in diameter. At 2.20 meters distance a voltmeter attached to the nozzle registered 20 volts. At 65 centimeters distance it registered 70 volts and at 20 centimeters 210 volts. The average man can stand a current of 50 volts without serious shock, so a fireman who holds his nozzle 5 or 6 feet from a live wire runs no great danger.

Mr. Tartaglini made the same experiment on two lines of alternating current, one with 2,300, the other with 4,600 volts, and the voltmeter did not register any current in the stream of water, although a slight shock was perceptible when he put his hand into it. With a chemical extinguisher he got a current of 1,550 volts at 225 millimeters from a wire carrying a current of 2,050 volts.

CALIFORNIA YOUTH EXPLAINS NEW WIRELESS PHONE.

Earl C. Hanson, a Los Angeles youth, states that he has evolved a wireless telephone apparatus capable of operating between the shore and boats at sea. Young Hanson believes his system will render life saving in the future far easier than it has been heretofore.

Hanson has been working on his idea for years. He has applied for a patent, and those who have inspected his workshop pronounce his scheme feasible. For the benefit of the skeptics, the inventor recently gave a demonstration at the Venice pier, when he explained how his apparatus works.

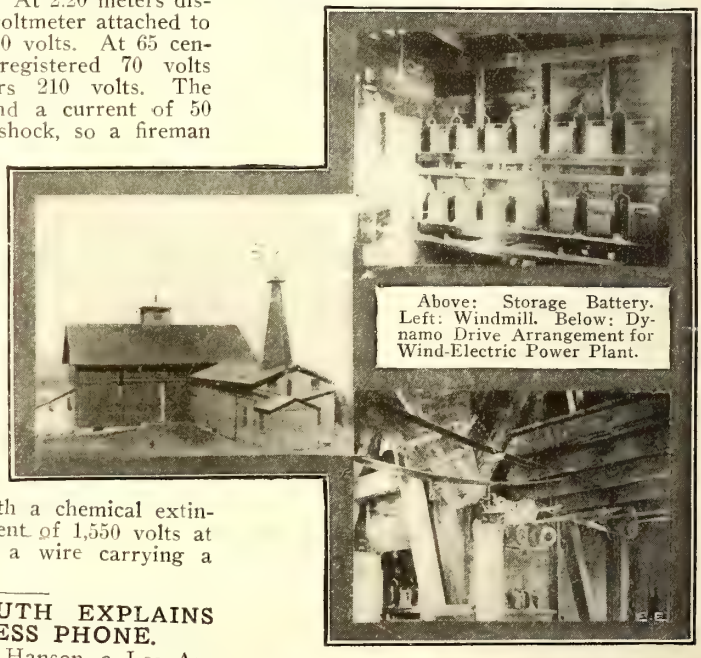
Hanson, who began his work on the instrument when he was 12 years old, declares that the apparatus is inexpensive. A case two feet square will hold it. It can be operated like an ordinary telephone. The world has been a long time waiting for such a device.

WINDMILL GENERATES ELECTRICITY FOR HOUSE AND BARN.

By H. E. Zimmerman.

It looks as though the farmer, who has learned to appreciate the cheap power produced by the windmill, is going to extend its utility by inducing it to make electricity as well as to pump water. A Wisconsin farmer—J. F. Forrest, of Poynette, that State—has adopted a very unpretentious and practical method of carrying out this idea. To a 12-foot windmill on his farm he has harnessed a dynamo. This, in connection with a storage battery, converts and stores the energy of the wind into that of electricity. The amount thus rendered available is sufficient to light a system of 25 lamps distributed through the house and barn and to operate an electric flatiron and vacuum cleaner. Feed is also ground for the stock and conveyed to bins through a canvas conveyor.

The lighting system is a low-pressure, 30-volt affair, while the flatiron and vacuum cleaner are supplied from a separate 110-volt generator. The storage battery and generators are located in a shed, or wing of the barn, over which the windmill is erected. Specially designed generators and governor pulleys serve to stabilize the usual erratic speed of the windmill. An automatic cut-out in circuit between the generator and storage battery keeps the current in the latter from flowing back into the generator and reversing its polarity. With the electricity costing practically nothing after the equipment is fully installed, the owner's plan is to use it lavishly while the wind blows, and save it during the calm. Some day the windmill-electric plant may be so common that we no longer will look upon it as a curiosity.



Above: Storage Battery. Left: Windmill. Below: Dynamo Drive Arrangement for Wind-Electric Power Plant.

AS OF OLD.

Fond Mother—"Bobbie, come here. I have something awfully nice to tell you."

Bobbie (age six)—"Aw, I don't care. I know what it is. Big brother's home from college."

Fond Mother—"Why, Bobbie, how could you guess?"

Bobbie—"'Cause my wireless won't work no more!"

The carelessness of some people is astounding. A recent report has it that a baker stepped on a cinnamon bun and the "currant" ran up his spine!

AN IMPROVED POLICE TELEGRAPH BOX.

By Warren E. Fastnacht.

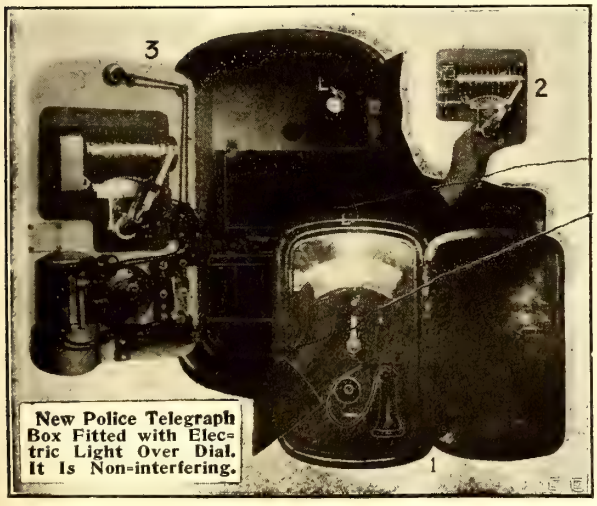
Police telegraph boxes are very often located in such a position that it is impossible for the officer to see the index dial at night, and unless he uses his electric pocket-light or a match he very often sends in the wrong report. In this improved box there is a light over the index dial, which is operated by the button in the end of the index lever; the officer pressing this button in the act of setting the lever to the proper code index, see Fig. 1. In other boxes use is made of illuminated dials of opalite glass, lighted from the rear. This opalite plate with black letters makes an efficient dial, both day and night.

In the smaller cities very often the boxes are placed far apart and, as the officers' beats overlap, a number of them report from the same box. The greatest number of signals which can be sent in from the boxes on the market at the present time is seven, and this does not meet the demand in many cities. Twelve different signals can be sent in from this new box and, as the code is made up of a number of round head screws properly spaced in holes on a revolving cylinder or drum (see Fig. 2), the code or the number of the box can be readily changed without removing the mechanism. In police reports each officer has a particular number or report at each box, and this number or report is always followed by the number of the box, so that the desk man knows exactly where the report comes from.

This set is non-interfering, as the moment the drum starts to revolve the index lever is locked and remains locked until it completes its function.

To protect the boxes and mechanism and also the officers from burn-outs or shocks, the inner boxes are wholly constructed of asbestos wood. The officers are further protected, aside from grounding the outside shells, by enclosing the entire receiver cord in a flexible rubber tube.

Very often there are repairs to be made after dark and it is not very satisfactory or handy for one man to use a flash-light or a lantern. In this box there is a small spot-light placed in an upper right corner of the inside chamber and mounted on a ball socket joint, which permits its being directed toward any part of the mechanism (see Fig. 3). This light as well as the one



New Police Telegraph Box Fitted with Electric Light Over Dial. It Is Non-interfering.

above the index dial are supplied from the local talking battery.

By the removal of only three screws, the whole of the signaling mechanism, including the index lever and starting lever, can be removed from the cabinet and taken in somewhere to be repaired. In removing this mechanism the index and starting levers pass through openings in the door of the inner chamber.

SUBSTITUTES FOR COPPER IN GERMANY.

So scarce has copper become in Germany, owing to the trying conditions of the war, that substitutes have been found to replace the copper wherever possible, especially in electrical plants, where, of course, such large amounts of this valuable metal are used. The new regulations of the German Association of Electrical Engineers cover this saving of copper by the substitution of other metals, notably zinc and iron.

Zinc busbars are advocated, and tables have been worked out for the carrying capacity of same, as well as for zinc bolts and zinc and iron wire. Where zinc is used its low mechanical strength, low elasticity, low melting point and its sensitiveness to high and low temperatures must be taken into account, of course. Wherever iron and steel are used for contacts they must be protected properly by means of zinc plating, lead plating, or else by greasing, etc.

With regard to iron busbars, the rule in the case of direct current for the permissible current is to have the relation of 1 to 2.8 to the permissible current in copper bars of the same dimensions. If the war continues copper will be nearly unknown in Germany.—*Elec. World.*

WIRELESS SERVICE DIRECT TO ARGENTINA.

Chauncey Eldridge, president of the Federal Holding Co., of New York City, which controls the Poulsen wireless telegraph patents in this country and has for three years operated a wireless system between San Francisco and Honolulu, announced recently that the company had obtained a concession from the Argentine Government for the erection of a high-power wireless station at Buenos Aires.

Mr. Eldridge said that it was intended to begin the building of stations with wireless towers 1,000 feet high near New York City and near Buenos Aires within a short time, and that probably within a year there would be for the first time direct communication between this country and South America by wireless.

The proposed wireless towers of 1,000 feet in height will be higher than any now in use, and the distance of 4,600 nautical miles between New York and Buenos Aires is a greater distance that any now spanned by ordinary radio stations. The longest wireless span at present in commercial operation is from Tuckerton, N. J., to Eilvese, Germany. The Tuckerton station uses the Poulsen wireless apparatus of less than 100-kilowatt capacity. The proposed plants will have a 300-kilowatt capacity.

AN ELECTRIC SIGN THAT DANCES.

One of the latest electric signs which interests thousands of persons nightly is seen herewith. We illustrate night view of the sign. The operation of this magnificent sign is indeed interesting as the mammoth figure, representing a Scotchman, continuously performs numerous steps of the "Highland Fling." This huge figure is 47 feet high and is mounted on a frame 50 x 50 feet. Upon the same frame the words "Haig and Haig" with the other words of the sign are mounted. The large letters are 12 feet high, while the others vary in size.



In this Latest New York Electric Sign the Highlander Dances Briskly, Attracting Great Crowds Nightly.

This sign employs about 2,000 incandescent electric lamps, which are controlled automatically by an ingenious flasher switch. This is another addition to the spectacular array of signs studding Broadway at 46th street, New York City, aptly called the "Great White Way." This unique display was built by O. J. Gude & Co.

OUR NAVAL RADIO SERVICE.

Our naval radio service now includes 47 land stations scattered all over the world. Two of these are high-power stations having a generating apparatus of 100 kilowatts or more. They are located at Darien on the Canal Zone and at Arlington, Va. A third station of the high-power type will be completed at San Diego within the next six months, while contracts have been let for two others—one in the Hawaiian Islands and one in the Philippines. These new stations are being constructed along the most modern lines. It is believed that they will have a much wider range of communication than any others in the world, and their completion will put the United States distinctly ahead of any other nation in radio equipment.

Why not improve your electrical education? Read *The Electrical Experimenter* every month.

The Tesla High Frequency Oscillator

By H. Winfield Secor, E.E.

TESLA, probably the highest authority in high frequency electrical engineering to-day, has not been dreaming these past few years, although we have not heard much from him, except through the daily newspapers, which now and then publish some world-startling interview describing a "marvelous" Tesla wave with which it is possible to communicate with Mars and several hundred other astounding stunts that the winner of the Noble physics prize probably never even thought of, much less attempted to accomplish.

Most of our readers have, no doubt, seen pictures of the famous Tesla wireless tower located at Shoreham, Long Island, and which structure has involved the expenditure of a vast sum of money. From this lofty structure, which was designed in the neighborhood of 20 years ago by Dr. Tesla and his associates, there was to be propagated an electric wave of such intensity that it could charge the earth to such an extent that the effect of the wave or charge could be felt in the utmost confines of the globe.

Our front cover illustration shows the Tesla tower in (theoretical) operation and, in line with some of the latest statements from this marvelous man, there may be perceived several dreadnoughts being blown to atoms, which is due to the high tension electric wave sent out from this center of vast electrical activity. Tesla, for obvious patent reasons, does not go into details just how whole fleets of a hostile navy can be destroyed in this way by means of powerful electric waves, but quite possibly he has in mind the fact that the latter can be tuned, undoubtedly, to a particular wave of certain frequency and power to accomplish this result when liberated from such a mighty station or oscillator as that located on Long Island. Such ships as the great steel shell dreadnoughts of to-day would, of course, have a large electrical capacity and this would help out the Tesla theory which covers the transmission and reception of an electric wave of sufficient intensity to do great good or damage, as the case might be.

The illustration on the front cover of this issue shows future possibilities which may be developed on the Tesla theory as a foundation. The location of the oscillator tower, from which the electrical energy is transmitted, and also the position of the war vessels being blown up are not to be considered literally in the way they are here shown. As a matter of fact, the enemy could soon shell the tower down.



Fig. 1. Probable Appearance of the Wonderful Tesla Oscillator Tower at Night—It Is Located at Shoreham, L. I., and Is Intended for Radiating Electrical Energy in the Form of High Frequency Waves Propagated Thru the Earth Itself—Tower Stands 185 Feet High.

and hence it becomes evident that if this system is ever perfected and applied practically, the elevated radio energy transmitting station will have to be placed at a considerable distance inland. Again, as this wireless energy can be transmitted hundreds and even thousands of miles without any appreciable loss, according to Tesla's beliefs and statements, no disadvantage or inefficiency would be incurred by so locating the tower away from the coast; but conjointly, on this theory, the invading fleet of war vessels could be destroyed when they were still several hundred miles off shore. Hence, it would be impossible for them to hurl projectiles this distance. Also presumably this method of detonating the powder magazines of the war vessels could be applied to similar containers of high explosives on land, such as those carried by the heavy artillery corps of an invading army.

Further, it may be said that Tesla, all in all, does not believe in the modern Hertzian wave theory of wireless transmission at all. Several other engineers of note have also gone on record as stating their belief to be in accordance with Dr. Tesla's. More wonderful still is the fact that this scientist promulgated his basic theory of *earth current* transmission a great many years ago in some of his patents and other publications. Briefly explained, the Tesla theory is that a wireless tower, such as that here illustrated and specially constructed to have a high capacity, acts as a huge electric condenser. This is charged by a suitable high frequency, high voltage apparatus and a current is discharged into the earth periodically and in the form of a high frequency alternating wave. The electric wave is then supposed to travel through the earth along its surface shell and in turn to manifest its presence at any point where there might be erected a similar high capacity tower to that above described.

A simple analogy to this action is the following: Take a hollow spherical chamber filled with a liquid, such as water; and then, at two diametrically opposite points, let us place, respectively, a small piston pump, such as a bicycle pump, and an indicator, such as a pressure gauge. Now, if we suck some of the water into the pump and force it back into the ball by pushing on the piston handle, this change in pressure will be indicated on the gauge secured to the opposite side of the sphere. In this way the Tesla earth currents are supposed to act.

The patents of Dr. Tesla are basically quite different from those of Marconi and others in the wireless telegraphic field. In the nature of things this would be expected to be the case, as Tesla believes and has designed apparatus intended for the *transmission of large amounts of electrical energy*, while the energy received in the transmission of intelligence wirelessly amounts to but a few millionths of an ampere in most cases by the time the current so transmitted has been picked up a thou-

sand miles away. In the Hertzian wave system, as it has been explained and believed in, the energy is transmitted with a very large loss to the receptor by electro-magnetic waves which pass out laterally from the transmitting wire into space. In Tesla's system the energy radiated is not used, but the current is led to earth and to an elevated terminal, while the energy is transmitted by a process of conduction. That is, the earth receives a large number of powerful high frequency electric shocks every second, and these act the same as the pump piston in the analogy just cited. These electrical impulses or shocks given to the earth are to be picked up at receiving stations by erecting a suitable capacity in the form of a metallic tower, as will be described more in detail hereafter.

Quoting from one of Tesla's early patents on this point: "It is to be noted that the phenomenon here involved in the transmission of electrical energy is one of *true conduction* and is not to be confounded with the phenomena of *electrical radiation* which have heretofore been observed, and which, from the very nature and mode of propagation, would render practically impossible the transmission of any appreciable amount of energy to such distances as are of practical importance."

He states further: "From my experiments and observations I conclude that with electromotive impulses not greatly exceeding 15,000,000 or 20,000,000 volts, the energy of many thousands of horse-power may be transmitted over vast distances, measured by many hundreds and even thousands of miles, with terminals not more than 30,000 to 35,000 feet above the level of the sea; and even this comparatively small elevation will be required chiefly for reasons of economy, and if desired it may be considerably reduced; since, by such means as have been described, practically any potential that is desired may be obtained and the currents through the air strata may be rendered very small, whereby the loss in the transmission may be reduced. It will be understood that the transmitting as well as the receiving coils, transformers, or other apparatus may be in some cases movable—as, for example, when they are carried by vessels floating in the air, or by ships at sea."

Tesla is not an idle dreamer, as many men are inclined to believe, but back in the year 1898 he succeeded, in some very elaborate tests carried out in Colorado, in producing high frequency electrical discharges, the like of which had never before been witnessed by man, nor have they been duplicated since, to our best knowledge. Some of these sparks measured 100 feet in length and produced a roar like the Niagara Falls. The multitude of mighty sparks and flashes produced a discharge so terrific that no human being could stay in the building in which they took place. Some of the sparks were as thick as a man's arm and others manifested even greater intensity. They were produced by a gigantic Tesla high frequency coil with which experimenters of to-day are more or less familiar in a small way. About 300 kilowatts were utilized in producing these discharges, which resembled actual lightning bolts and not imitation ones. The amperage measured 800 and the voltage was up in the millions. The illustration of these sparks, as well as Tesla's early work along this line, have been covered in previous issues of *The Electrical Experimenter*.

Regarding the Tesla tower on Long Island and the general engineering features of same, we may refer to his patent which covers the design of the high frequency apparatus of mastodonic design and capable of charging the structure at several million volts pressure. The external appearance of the Tesla generating plant and antenna support (185 feet high) are shown

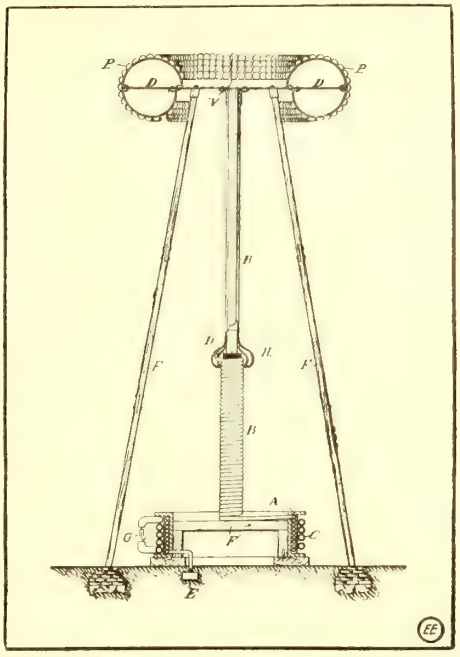


Fig. 2. Structure of the Tesla High Frequency Tower and Exciting Coils.

at Fig. 1. The huge high frequency step-up transformer is shown diagrammatically at Fig. 2.

Referring to this great structure which involves several peculiar design features, we see at the upper extremity a large capacity, D. This is made up of a metal framework upon which there is mounted a vast number of hemi-spherical metal electrodes. These are advocated for the reason that the minimum electrical leakage will then ensue. As points, of course, discharge any high tension current as rapidly as possible, they are done away with, as this is exactly what Tesla does not desire to have take place in this instance. The complete electrode comprises a suitably shaped metallic ring and the half-spherical electrodes appear at P P. Hence, within a reasonably small space an extremely large electrical capacity is formed. This capacity rests upon insulating supports, which in turn are well insulated from the earth.

The high frequency exciting circuit comprises a massive coil, A, which is in close inductive relation with the primary winding C, one end of which is connected to a ground plate, E. The other end of the coil is led through a separate self-induction and auto-transformer coil, B, and the metallic cylinder B^1 to the terminal D. At

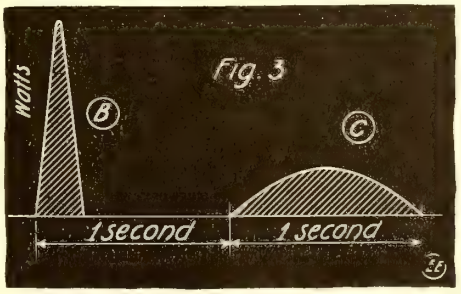


Fig. 3. Diagram Showing How the Rate at Which Energy Is Dissipated Increases as the Time Element Decreases.

the apex of the mast the connection with D is to be made at or near the center, Tesla specifies, in order to secure a symmetrical distribution of the current. Otherwise, when the frequency is very high and the flow of large volume, the performance of the apparatus might be impaired. The primary C is excited in any desired manner, from a suitable source of current G, which may be an alternator or condenser, the important requirement being that the resonant condition is established; that is to say, that the terminal D is charged to the maximum pressure developed in the circuit.

The adjustments should be made with particular care when the transmitter is one of great power, not only on account of economy, but also in order to avoid danger. It has been shown that it is practicable to produce in a resonating circuit as E A B B D immense electrical activities, measured by *tens and even hundreds of thousands of horsepower*, and in such a case, if the points of maximum pressure should be shifted below the terminal D, along coil B, *a ball of fire* might break out and destroy the support F or anything else in the way. An induced earth current out of phase with a "tower capacity" current meeting at any point along the coil, etc., would buck each other and so balls of fire could be produced; the instantaneous value of the energy so involved being truly astonishing. For the better appreciation of the nature of this danger it should be stated that the destructive action may take place with inconceivable violence. This will cease to be surprising when it is borne in mind that the entire energy accumulated in the excited circuit (instead of requiring, as under normal working conditions, one-quarter of the period or more for its transformation from static to kinetic form) may spend itself in an incomparably smaller interval of time, *at a rate of many millions of horsepower*. The accident is likely to occur when, the transmitting circuit being strongly excited, the impressed oscillations upon it are caused, in any manner more or less sudden, to be more rapid than the free oscillations.

It may seem quite impossible for many of our readers to comprehend the large figures cited by Tesla with regard to the voltage and horsepower liberated or propagated from such a structure as he has designed. However, by referring to Fig. 3, this matter can be more readily understood. This diagram shows how a graphic curve, C, would appear for, say, 100 horsepower liberated or passing through a circuit for the time period of one second. Now consider that instead of this 100 horsepower of energy being allowed to pass along in normal fashion for a period of one second, that it is heaped up or liberated in about one-fifth of a second as at B. The horsepower or watts, let us say in this case, would be dissipated at a much higher intensity rate than was the case at C. In other words, the rate of dissipation in this instance would be 500 horsepower for one-fifth of a second instead of 100 horsepower for one second.

Now consider that a Tesla current as produced by an oscillatory discharge from condensers and the like take place in very small fraction of time, then Tesla's statements in his patent and aforementioned with regard to the production of hundreds of thousands of horsepower is not so fallacious at it may seem. In an interview with one of our editorial staff he has vouchsafed the information that the oscillator here pictured is supposed to be excited with an input of 300 kilowatts. The average person then begins to gasp for air. An input of only 300 kilowatts! How, then, could this tower be caused to oscillate and liberate energy at the rate of hundreds of

(*Continued on page* 663.)

Electricity Wonderful Aid to Modern Surgery

THERE have been various improvements made in surgical instruments in the past few years, and the apparatus described here is the final result of extensive experiments and painstaking labor on the part of specialists to evolve a device that would simplify operations on bones.

Heretofore an operation which necessitated the sawing or cutting of bones was more or less clumsily done, due to the fact that the instruments entirely suitable for this purpose were not to be had and the surgeon did the best he could with those at hand.

The surgeon of to-day, however, is equipped with a unique instrument for this work in the way of an electrically operated bone set, which is shown in Figs. 1 and 2. The outfit comprises a source of power, in this case taking the form of an electric motor made of very light material, a foot switch for controlling the motor and various attachments as shown in the illustration. They consist of a selection of various small drills, saws and cutters, and are all interchangeable. They are held in place by an automatic catch built in the motor shaft. A specially made angular twin saw is provided with this outfit and is used for very deep wounds.

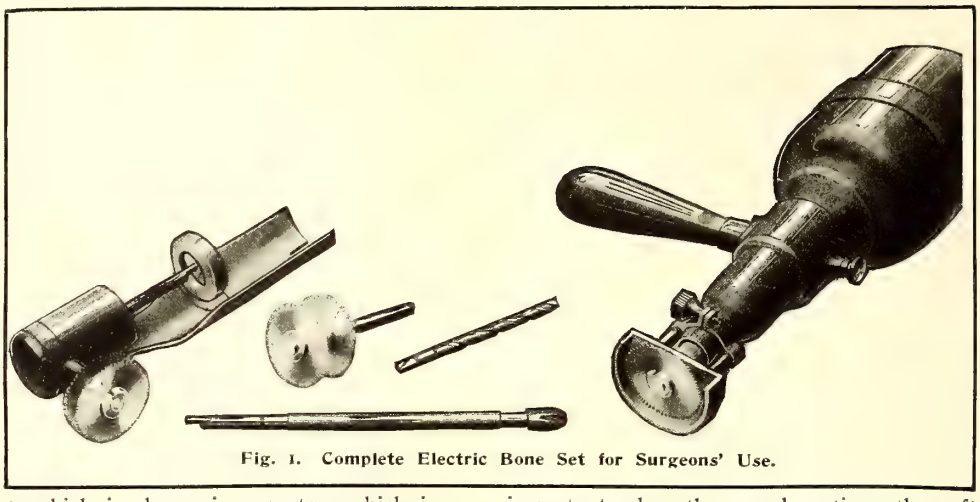


Fig. 1. Complete Electric Bone Set for Surgeons' Use.

The fact that these attachments can be so rapidly changed is of great value to the surgeon, as he can change from one to another almost as quickly as he could select an instrument from the table. Time is an important factor in any operation, as the faster the work is done the less danger there is of fatal results. Besides being very light and comfortable to handle, the motor used is very powerful. The apparatus as a whole is easily sterilized and thus reduces the liability of infection to a minimum.

The motor being specially designed for this work has several refinements not found in other small motors of a similar type. The most noticeable of these improvements is the way in which the flexible cable is connected to the apparatus. Formerly this flexible cable has been of more or less trouble, due to the fact that it often became heated and stalled the motor. In this design such trouble is done away with entirely.

The current to the motor is run through the foot switch previously mentioned and, as the name indicates, the latter is operated by the pressure of the foot. With this type of switch the surgeon had at all times perfect control over the speed of the motor, which is very important when the different attachments are being used.

With this bone cutting instrument bone grafts and their recipient beds can be speedily and accurately made with a minimum expenditure of time and work, with the consequent lessening of the danger from infection which contributes to the ultimate success of the operation.

Of the utmost importance to modern surgery is the method of administering the anaesthetic. In days gone by, when the surgeon was compared more or less to a "butcher," the usual manner of anaesthetizing the patient was to place a piece of cotton over his nose and mouth and then pour the anaesthetic, chloroform or ether, over the cotton. The vapor therefrom was, of course, inhaled by the patient with the desired results.

This method was improved upon by the use of a mask which was placed over the face. It had a receptable at the top in which gauze or cotton was placed. The liquid was poured on and the vapor, of course, inhaled with resulting unconsciousness.

There were drawbacks even to this method, and physicians started experimenting with apparatus that would simplify this part of the operation. Several schemes were worked out, but none possessed the great efficiency or ease of manipulation of the appliance illustrated in Fig. 3. This apparatus consists of four units: 1. A motor blower and rheostat. 2. Ether or chloroform container. 3. Mercurial manometer registering from 5 to 50 mms. and capable of being easily set for any operation and acting thereafter automatically. 4. Hot water for adding both heat and moisture to the vapor. Another form of an etherizing machine is depicted in Fig. 4.

The apparatus shown at the right is used for administering the gas to the patient. The mask is adjusted over the face, and the amount of ether to be given is placed in the vaporizing chamber. As soon as the heat is applied the ether is quickly vaporized and forced into the patient's lungs by means of the blower.

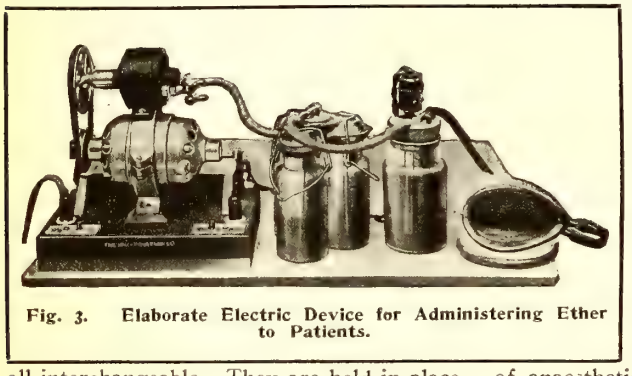


Fig. 3. Elaborate Electric Device for Administering Ether to Patients.

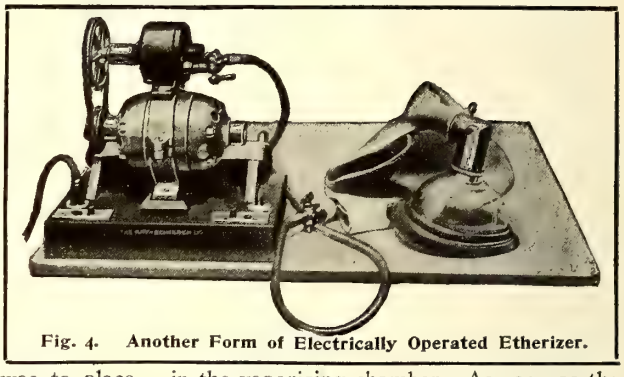


Fig. 4. Another Form of Electrically Operated Etherizer.

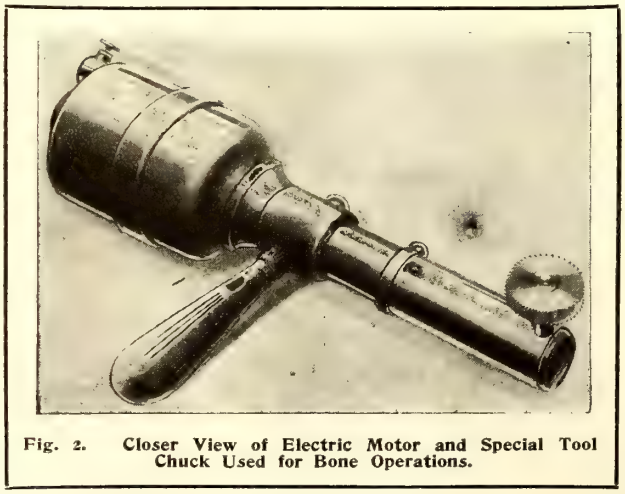


Fig. 2. Closer View of Electric Motor and Special Tool Chuck Used for Bone Operations.

GREAT FUTURE FOR X-RAY.

The results already achieved by the X-ray in combating ills are only a hint of ultimate successes expected, specialists recently told the annual convention of the American Roentgen Ray Association. Dr. W. D. Coolidge, of Schenectady, N. Y., said that the investigators were dealing with the future and not so much with present attainments, because they saw tremendous discoveries clearly ahead within striking distance.

He spoke of the need of standardization and checks upon manufacturers of the apparatus used, and asserted the belief that it will be as simple a matter to standardize the equipment of X-ray specialists as it was the incandescent lamp. Experiments had shown, he said, that it was possible to get one-third more radiating energy with the direct current than from the alternating current and to vastly increase the intensity of the ray with the aid of revolving targets.

Edison Perfects Storage Battery Miners' Lamp

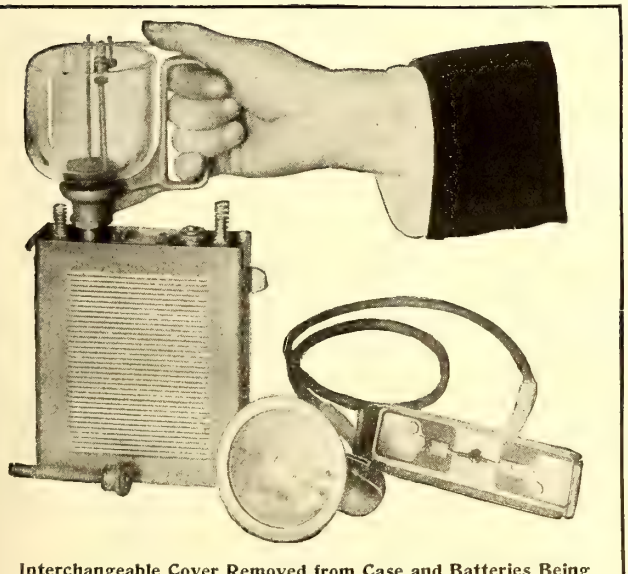
The latest device brought out by the Edison laboratory is a highly perfected storage battery miners' lamp. This is developed to the finest detail, and it has been considered so meritorious that it was awarded the Rathenau Medal of the American Museum of Safety. This medal is placed at the disposal of the above-mentioned museum by the Allgemeine Elektrizitäts Gesellschaft, of Berlin, to be awarded for the best device or process in the electrical industry for safeguarding industrial life and health. The Edison mine lamp was the first to receive this marked honor.



New Edison Battery Miners' Lamp in Use. The Angle of Illumination Is Well in Excess of the 130 Degrees Required by the Government.

The illustration herewith shows respectively the perfected Edison mine lamp in actual use down in a coal mine and the thumb actuated refilling device which is not only a great time and labor saver, but is also very cleanly in its action, preventing the spilling of the solution over the outside of the battery casing, etc.

The battery container holds two cells of the nickel-iron-alkaline type, and thus produces two and one-half volts. The elements, nickel hydroxide and iron oxide in a potash solution, are encompassed by a strong, nickel-plated steel container, hermetically sealed except at one small outlet for the escape of the harmless and odorless gases when being charged. The cell may be turned upside down without in any way proving disastrous to the miner or to the action of the battery. This is arranged for by the unique design of the ventilating tube, which prevents the escape of any of the solution, even though the cell be violently shaken. The cell fits snugly into a light outer casing, which is rust-proof and made of monel metal. The battery is held on the miner's back or, rather, at his waist line by means of a leather strap passed around the body. An extra heavy flexible conductor leads up to the lamp, which is fastened on to the cap. The lamp is usually lighted when handed to the miner and they are generally charged in groups every night at a central charging room or station located at the mouth or the entrance to the mine. The battery case is secured by a padlock so that it cannot be tampered with. The whole outfit proves practically foolproof and as safe as any lamp available for the purpose.



Interchangeable Cover Removed from Case and Batteries Being Watered by Automatic Filler.

The automatic battery filler and "watering" gauge shown in the second illustration makes it possible for unskilled attendants to readily care for the batteries. It assures absolutely proper filling in every case when employed, as it not only indicates when the normal level of the battery has been reached, but it also automatically cuts off the flow of water at that point. It can likewise be used for renewing the alkaline solution.

NEW HIGH-CANDLEPOWER FLASHLIGHT.

A novel and useful flashlight has been perfected by George K. Burleigh, known as the Fire Fly Light. It has many new features as well as being very attractive. The case (Fig 1), which contains an ordinary dry battery, is enameled red, the fiber disc which covers the battery white, the handle blue. The two tungsten lamps are operated from one switch, and by mirror reflection triple the illumination given by any single battery light is obtained. It gives a diffused and not a concentrated light, so that by placing it in one corner of a small room you can read in any part of the room. Other new features are that if anything happens to one of the lamps you always have the other in use, and the U clip shown in the cut, which slides up between battery and battery case, can be screwed to the floor of automobile or carriage, in any safe place, and the light can be pulled off the clip instantly to measure gasoline, read signboards, make repairs around motor, et cetera.



Fig. 1. New Double Bulb Electric Lantern.

The second illustration shows the strap furnished with each light for hanging it around the neck, with battery buttoned inside the coat. This gives at all times the free use of both hands. In this way it is especially useful in looking after the furnace, for the farmer pitching down hay or milking cows, firemen rushing from one room to another and carrying occupants overcome by smoke, etc. The whole outfit weighs about four pounds.



Fig. 2. Triple Bulb Battery Lamp Strapped Around Neck. Excellent for Firemen and Others.

UNIQUE DIVING BELL TO HELP RAISE SUNKEN SHIPS.

A California inventor has perfected a submerging or diving bell formed of a single hollow steel casting, which is capable of accommodating an operator, and it is



A large Diving Bell Designed to Aid in Raising Sunken Vessels.

provided with powerful securing or retaining magnets, as well as electric searchlights and large glass windows, through which the submerged wreck may be inspected This salvage machine, if so it may be termed, is suspended on a steel cable from a tender ship on the surface, as our illustration shows. When the steel shell attains the proper position with respect to the sunken vessel, the electric current flowing through an insulated cable from the tender on the surface is thrown into the powerful electromagnets and the entire ball is held rigidly at that particular point against the hull of the vessel. A specially devised and controlled drill then bores a hole in the steel shell of the sunken ship and by an ingenious arrangement of screws on the outside of the salvage machine, the body proper of same can be moved several feet laterally or vertically, with respect to the holding magnets. After a hole is drilled, this permits the operator within the bell to manipulate a magnetized arm, which picks up one of the pontoon cables, as may be noted in the illustration. The end of this cable is fitted with an automatically locking toggle hook which is secured in the hole previously drilled. Thus the operation is repeated until all the pontoon cables are fastened to the hull of the boat.

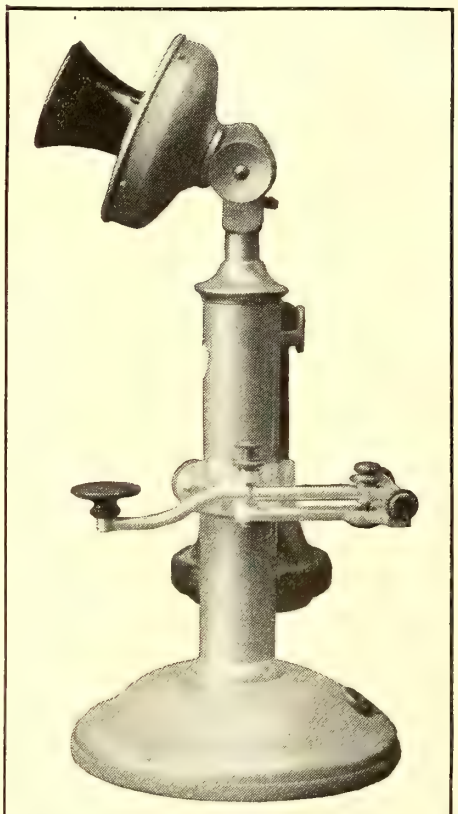
These pontoons are fitted individually with electric motor-driven pumps, so that the water can be pumped out of same separately or all together simultaneously; in this way the vessel is supposed to be readily raised to the surface, when it can be towed to the nearest harbor or to shoal water for overhauling and repairs.

Such work as this is extremely interesting to a large class of people, as many of the stories of sunken vessels carrying vast amounts of gold are not mythological, but actual facts, and a great number of these wrecks, worth many millions of dollars, are definitely charted on the hydrographic maps of the Government. To reclaim such wrecks and the buried treasure thus lost has been the dream of untold numbers of inventors, and this device bids fair to accomplish some valuable work in this direction.

TELEGRAPHING OVER TELEPHONE LINES WITH SIMPLE DEVICE NOW POSSIBLE.

A patent has just been allowed to Paul P. Banholzer, of Philadelphia, Pa., on a mechanical telegraph instrument for telegraphing by wireless telephone and over telephone circuits. It is claimed that this instrument will further introduce the dot and dash system of telegraphy, which can be understood by any wire operator. Furthermore, the sound it produces is unmistakable and carries much farther than the voice.

For telegraphing over telephone lines the modified key here illustrated is clamped to the post of a desk telephone and when the key is manipulated the Morse code characters are received at the distant end of the circuit clearly and distinctly. The dots and dashes on the key are transmitted



Simple Key Attachment Enables You to Telegraph Over Any Telephone Line

mechanically to the diaphragm of the microphone through the metal stand parts and are transmitted over the line, as are voice currents, and reconverted into sound waves in the receiver at the other end. A desk telephone, with this device attached, can be "jacked" into any telephone circuit and used as an extension telephone. In this way the hinged fastener can be used anywhere without having to change the fastener or use bushings.

This instrument is stated to be an especially useful device in connection with telephone train dispatching, since the telegraph system could be used when telephone conversation is not understood or is otherwise difficult owing to bad weather effects on the line, etc.

It is claimed that this key could be used with advantage in branch telegraph offices where there is but one telegraph wire. Such offices, as a rule, have a telephone, and this circuit could be used to forward their messages without having to wait their turn on the telegraph circuit.

Quite a number of these instruments are in successful operation in the South and West, and reports indicate that they now form a part of the permanent equipment of those lines.

There can be no induction on parallel lines, as no additional battery is required to operate the instrument. What has been said in regard to the wire telephone system also applies to the wireless telephone system.

CARNEGIE SENT FIRST TECH. WIRELESS MESSAGE.

Andrew Carnegie sent the first message from the new wireless station at the Carnegie Institute of Technology, Pittsburgh, Pa., the most powerful in the State, and one of the largest in the country, when he attended Carnegie Day celebration, Nov. 23. The outfit is nearly twice as strong as the average outfit on United States battleships, and will send messages as far as Colon, Panama.

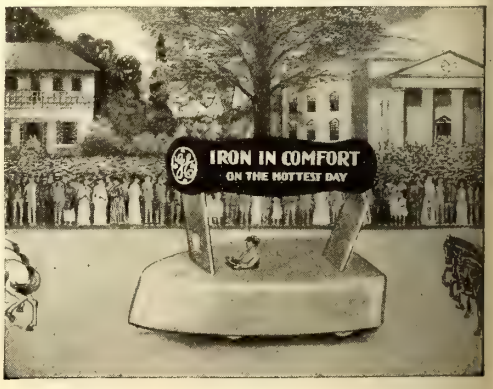
The Radio Club of 30 members installed the apparatus. The club is composed of Tech. students and wireless men of Pittsburgh. It has applied for membership in the American Institute of Radio Engineers.

ELECTRIC IRON MAKES INTERESTING PARADE FLOAT.

In line with the widely extended advertising campaign during "Electrical Prosperity Week" there were many parades and electrical demonstrations conceived and carried out to further the aims of this business-getting propaganda.

Among the very interesting floats and beautifully decorated autos that appeared in the various parades there was one that seemed to appeal to the public more than the rest. This resembled a gigantic sad-iron mounted on an automobile. The illustration herewith gives some idea of the appearance of this unique float. In one of these recent events held at Liberty, N. Y., the sad-iron float was selected as one of the best decorated of all the entries made.

Such decorated autos or wagons do not cost an exorbitant amount, and the one just referred to entailed an outlay of about $31. This is very low when the size of the float is considered, the over-all dimensions of the outfit having been 16½ feet long, 7 feet wide, and 9½ feet high. Muslin was used to make a smooth outline of the base of the sad-iron, being stretched over an under



A Flatiron Float that Can be Built for $31 or Less.

framework or skeleton made up of some light wooden strips. Storage batteries and low-voltage tungsten lamps enable some wonderful, and spectacular effects of this nature to be attained at a nominal cost.

Electricity the Beneficent

By Benjamin G. Lamme

Cffief Engineer Westinghouse Electric & Mfg. Company, and Member Civilian Naval Advisory Board*

IMAGINE, if you can, that when you awake to-morrow morning, the whole world will be suddenly without electricity in any of its present forms. Have you even a faint idea how it would affect your every-day life? What would happen if such a cataclysm should take place over night? How would it affect humanity? This is the theme of the present article selected by its distinguished author. It makes good reading and brings home to us the fact that the world in its present state is vitally dependent upon the mysterious fluid.

THE benefits of electricity to mankind are so various and so far-reaching that it is difficult for any one person to fully appreciate them. These benefits are both direct and indirect, the latter sometimes far overshadowing the former. Many of the present generation are so accustomed to electrical appliances and methods that they do not fully perceive the large part such take in our daily life. It has been said that one cannot fully appreciate a thing until he has to do without it. This points to a very effective way of calling attention to the far-reaching influences of electricity in the life of the world.

Let us assume that by some means, all electrical apparatus, methods and usages are suddenly withdrawn from the world. By considering the consequences of this we can possibly get a fair idea of the scope of the electrical field.

Let us consider first the general subject of transportation. Possibly no other activity has had as great a bearing on the present high development of mankind as our modern methods of transportation. Taking steam operation, wherein does electricity play an important or controlling part? Or, by a more specific question, supposing the electric telegraph were suddenly eliminated, how would general railway transportation conditions be affected? They would be completely disorganized temporarily, and would be very greatly handicapped permanently. Rarely is it appreciated to what an extent our great railway systems are conditioned upon means for almost instantaneous communication between distant points. Without such means a busy railroad could only operate upon an exact time schedule. Once that schedule is broken, disorganization and disaster would follow. Incidentally, someone will suggest that if the electric telegraph were eliminated, the railroads would turn to the telephone. But this again is an electrical apparatus.

A second great item in railroad transportation at the present time is electric signaling for the dispatch and control of trains. If eliminated, this would certainly mean a great step backward, especially in sections of very heavy and frequent railway service.

What would be the effect of complete cessation of electrical operation of city, suburban and interurban cars? In the cities we might go back to horse cars for the surface lines. The service would be almost unbearable, but might be possible. Elevated trains in large cities could go back to steam, however, with great objections from adjoining business firms and residents. But subways—here would be a real nut to crack.

In suburban service, the elimination of the electric car service would spell disaster, except to those relatively few individuals who could have their own equipages. How few appreciate that the rapid growth of suburban districts has been consequent upon electric railways. Autobusses and "jitneys," or some other form of gasoline engine equipment, might furnish a solution eventually, but then, how about the electric spark for ignition?

Again, let us consider interurban car service. No other means can faintly compare with the electric car systems in bringing the people of city and country together. Steam service, with its infrequent trains, did little in this direction. The figures giving the great growth of passenger traffic between country and city districts following electric car operation, tell a most interesting story.

Electric haulage in coal mines is now standard practice. Decrease in fire risks and increased capacity are two prime reasons which have led to electric operation. Eliminate the electric current and coal mining can doubtless be carried on with more or less success, but with decreased production and increased cost, which must be borne by the public. We can always go back to the old ways of doing things, but we will have to pay the price.

In water transportation electricity, perhaps, has not played such a conspicuous part as on land. Yet if the electric installations on ocean vessels were eliminated, there would have to be quite a reorganization. Electric propulsion of large and high-powered vessels promises to be one of the most important steps in naval engineering in the near future. Wireless telegraphy has become a necessity in modern sea service.

Taking up next our business and industrial life, let us imagine a few of the things which would happen if electricity were entirely eliminated. Without the telegraph, business would be very badly handicapped, although it might limp along after a fashion. But the telephone—here would be the rub, if we had to give it up. Whole systems of conducting business are dependent upon the telephone. Disorganization would be certain to follow in many lines if it were eliminated. Even home-life would be greatly affected.

Let us next consider the elevator. What has been its influences on life and business in the cities? How about the large many-storied department stores? Can anyone conceive of a practicable 20 or 30-story skyscraper without elevators? And one must remember that most of these elevators are electrically operated. True, there are other very good methods of operating them, but nevertheless, the elimination of the electric elevator would make a large gap in our methods of vertical transportation.

This leads us to a very common piece of apparatus, namely, the electric motor. This has come into use so gradually, and with so little ostentation, that we almost feel that it has always been with us. Yet, in less than one generation, it has revolutionized all kinds of manufacturing establishments and industries. Take the electric crane for instance, what would the great industrial works of the present time do without this particular application of the electric motor? Take the use of electric motors in general throughout such establishments. How would the necessary power be distributed over the vast areas of modern manufacturing plants if electricity were eliminated? Possibly a way could be found, but in most cases it would require a complete reorganization of many of our present industrial methods, and efficiency would take a long step backwards.

In the smaller shops and power applications, the electric motor fills a fully as important place. Small steam plants are utterly impracticable in some places. Gas or gasoline engines are often very objectionable, but still possible. But how about the electric spark for ignition, if electricity is to be eliminated? It must also be kept in mind that many establishments using power have been so designed that the replacement of the electric motor by any form of steam or gas engine is not practicable for many reasons outside the mere question of ability of the latter to develop the required power. Available space, high temperatures, fire risks, disposal of burnt gases, noise, and many other conditions enter into this matter.

Outside of shops and industrial plants, the electric motor also has a very wide field of application, and many kinds of service have developed simply through the availability of the electric motor as a source of power. This part of the subject is too large to allow consideration in detail in any article of limited scope.

Coming now to one of the oldest and best known fields of electric activity, namely, electric lighting, we find a class of service the abolishment of which would be felt by all classes in civic life. If electric street lighting were abandoned, we could doubtless manage with some other form of illumination, but the results probably could never approach the present standard. In the case of interior lighting, the result of a replacement of the incandescent lamp by other forms of illumination would create still more dissatisfaction than in the case of street lighting. It may be said that the vast majority of electric light users would pay a greatly increased price rather than be obliged to give it up in favor of any other known method of illumination.

Another class of electric service of a comparatively recent period is represented by household utilities, such as electric irons, toasters, coffee percolators, and other electric heating appliances. Motors for general household purposes, for running sewing machines, washing machines, etc., are becoming rather common. These are luxuries which are fast becoming necessities. If these were eliminated a big gap would be created, even though they represent a comparatively new field of application.

The above is only a very incomplete presentation of the direct possibilities which would occur in case there was a complete cessation of all electrical activities. Many of the special applications of electricity such as electro-chemical, electro-metallurgy, electro-fusion, etc., have not even been touched upon, and yet great industries have been built upon them. The

(*Continued on page* 656.)

* Prepared exclusively for The Electrical Experimenter.

GEORGE SIMON OHM.
MARCH, 1916, MARKS HIS 128TH BIRTHDAY.

(Born 1787—Died 1854.)

In 1827 Dr. George Simon Ohm, a German physicist, rendered a great service to electric science by his pamphlet containing his theories that the flow of electricity was governed by certain fixed laws. It explained what is accepted and known to-day as "Ohm's Law," and the "Ohm" is now universally employed as the unit of resistance in an electrical circuit. This law states that *The current varies directly as the electro-motive-force, and inversely as the resistance of the circuit.* Like all great inventors, Ohm was ahead of his time, so his ideas were ridiculed by great and small.

He was the son of a thrifty locksmith, of keen intelligence, and was born March 16, 1787. George Simon Ohm started his career in the village of Erlangen, Bavaria, as a helper in his father's shop. He inherited a love of mathematics from his father, a man of studious disposition. The parents early recognizing the latent talent in their son, accumulated enough money to send George to college. Owing to lack of funds, he was compelled to forego his schooling a few years later. He then reluctantly turned to teaching in a primary school.



George Simon Ohm, After Whom the "Ohm," Unit of Resistance, is Named.

This sudden financial stress did not daunt the young locksmith student one bit. He filled in most of his spare moments studying, but it must not be thought that he gave up all outdoor pleasures. Unlike Ampère, he was popular among the students and professors and joined in all the social life and athletic games.

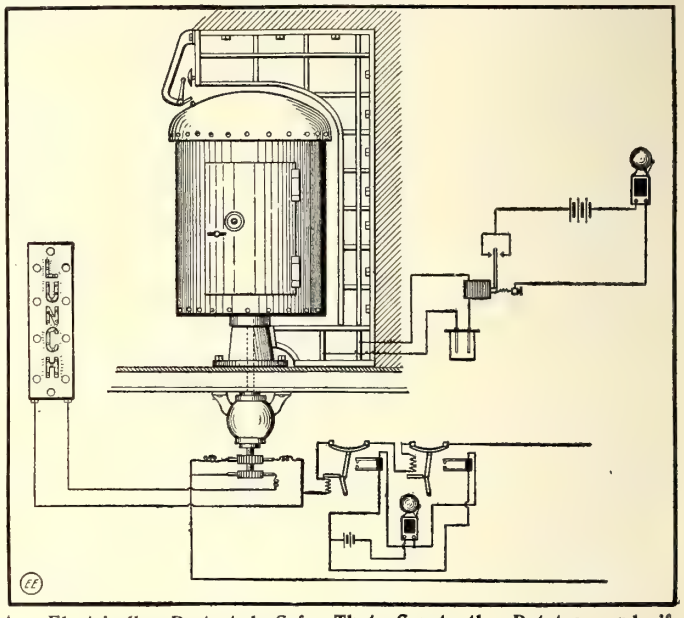
In 1817 George Simon Ohm was appointed professor of mathematics in the Jesuit Gymnasium at Cologne. The following year he published his famous "Elements of Geometry." He resigned a few years later and went to Berlin, where he became interested in electrical experiments. Ohm then pushed his researches in the footsteps of Galvani and Volta, the results of which were embodied in a pamphlet called "The Galvanic Circuit."

About 14 years after publishing his theories, when he was in the midst of his wonderful career, Ohm was awarded the Copley medal by the British Royal Society in 1841. For a time thereafter professional jealousy reduced Ohm to a condition of comparative poverty, but regardless of this he continued the course of his investigations. The International Congress of 1881 gave Ohm's name to the unit of electrical resistance, and so his name came to be one known to all electricians in every part of the globe. Wherever you find the volt chasing the ampere around the circuit, there also will you encounter the "ohm," who bucks their onward rush with all the strength he possesses. Ohm's law written algebraically, $C = \frac{E}{R}$, ($C = \frac{E}{R}$), has been adopted as the emblem of the National Electric Light Association, one of the most powerful scientific organizations extant to-day.

Electricity Renders Safe Impregnable.

By George C. Denny.

Electricity, the adroit crook's most formidable enemy, is forever beating him at his own game. It moves silently and quickly, strikes when least expected and, landing him behind the bars, prevents him from obtaining his much-desired haul. In a revolving safe, the subject of a recent patent, which appears to be the latest invention for foiling the expert cracksman, the unknown medium plays the leading role. By continuously turning the safe, which may be made still more impenetrable and secure by placing it in an enveloping sheath, electricity will render his drills and other tools of this class ineffective against it and, moreover, prevent the use of an explosive as by pouring it in the cracks in the safe or in a hole bored for that purpose, as is usually done. The motion of the safe and sheath, too, will attach to it so many uncertainties that the ambitious yeggman who might smilingly tackle the job, were the safe at a standstill, would soon turn away for an easier one with less risk.



An Electrically Protected Safe That Constantly Rotates, and if Tampered with Gives a Code Signal on the Sign Outside the Building.

That the motion of the safe may not be slowed down or stopped, over-load and under-load cut-outs are provided which are acted upon by the motor which turns the safe and which runs at a regular and predetermined speed. When one of these cut-outs is placed in action by an over- or under-load on the motor, a signal is promptly given that the safe is being tampered with.

To indicate the position of the safe door a bell mounted in a certain place on the sheath is struck, or a light placed in the proper position energized when the door has made a complete turn. These devices become necessary when the safe is placed in a niche in the wall or surrounded by a lattice work, as shown in the illustration. This manner of placing the safe effectively prevents its motions from being followed and the safe or sheath from being worked upon. The lattice work is also wired, so that any tampering with this structure would cause the sounding of an alarm.

A street sign with a number of lights, secretly wired to the safe and placed outside, would, by the alternate lighting of the lamps, caused by a commutator on the motor shaft, inform a watchman that the safe was intact at the completion of each revolution. Another novel method of protection would be to place the safe in a window, and the revolving thereof, besides attracting attention and acting as an advertisement, would insure the safety of its contents.

CLASSIFIED!

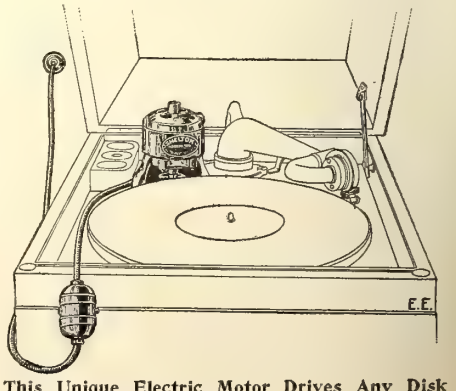
The applicant for the post of second wireless operator seemed somewhat dense, but otherwise appeared to be a clean-cut chap.

"I suppose you are a single man?" asked the port operator during the conversation.

"Er—er, no, sir," he stammered; "I'm twins."

A MOTOR THAT OPERATES ANY DISK PHONOGRAPH.

One of the latest electrical motor productions brought out by a New York concern appears to solve a very important problem which has long confronted the owners of a Victrola or other disk-type talking machine. This motor, which sells at a nominal price, does not have to be attached or screwed fast to the cabinet of the talking machine in any way, but simply rests on the shelf of same. On the lower end of the motor shaft is secured a friction pulley, which by frictional contact with the disk platen of the phonograph drives it at the proper speed. The regulator on the talking machine can be employed in the usual way for varying the speed of the record.



This Unique Electric Motor Drives Any Disk Style Talking Machine. Does Not Mar the Cabinet.

RADIO AMATEURS TO RELAY MESSAGE OVER U. S. ON FEB. 21.

Another radio M. S. G. (message) will be relayed from Rock Island Arsenal, Illinois, on Feb. 21. This radiogram will be delivered to 9 X.E. by the U. S. Army officer in charge of the arsenal station.

Owing to the fact that Feb. 22 is Washington's Birthday the message will be partly military in nature and also in keeping with the spirit of the day, which is dear to the heart of every loyal American.

It will be sent out on a Q. S. T. by many stations—special and amateur. It will be up to the many stations listening in to pick up the M. S. G., as the list of sending stations, their time and wave length will be given in the final instructions.

Each Governor and Mayor of every State throughout the United States will receive this message. Arrangements have been completed with the Boy Scouts of America to assist in delivering it wherever possible, and suitable ceremonies will be held at Bunker Hill and Mt. Vernon by these coming citizens of the U. S. A.

Valuable assistance has already been given by the various local and national radio clubs. The A. R. R. L. have promised their assistance. Every wireless amateur in the country is requested to "talk" this over with his favorite relay station. Telegram blanks will be furnished each receiving station later by 9 X.E.

N. A. A. (Arlington) has promised to assist in this great undertaking, the same as it did during the Rotary relay message sent broadcast on Dec. 31 last, by sending out a warning to all amateurs to "keep out," after the N. A. A. routine report of Feb. 21, 1916.

We all owe our thanks to Capt. Bullard, who has given us every assistance. All are requested who may be assigned the delivery of this message in their respective States or cities to deliver it, no matter where your man may be. Yours is a perfectly legitimate mission and you have no cause to fear anyone—just land your man and give him the telegram.

Yours for a great success, 9 X.E.

[*The Rotary M. S. G. of Dec.* 31, 1915, *was received in Texas and Utah. All States between these received the radiogram. Also Niagara Falls to Washington, D. C., and all cities between received it.*]

UNIQUE ELECTRICALLY LIGHTED TRAFFIC SIGNS.

The accompanying illustration depicts



Mt. Vernon, O., Makes Use of Portable, Electric-Lighted Traffic Signs.

the unique and also inexpensive form of electrically lighted traffic signs which have been erected at the four entrances to the public square of Mt. Vernon, Ohio. As noted from the illustration, these signs read, "Keep to Right." These words are visible to traffic in either direction, both night and day. At night there are two 25-watt tungsten lamps suspended from brackets above the sign on either side of same, so that it can be read at a considerable distance.

The upright standards supporting the sign and tungsten lamps are constructed from 1-inch conduit. Above the lamps there extends a 10-foot piece of ¾-inch conduit, through which the feed wires for the lamps are run. These wires are connected with the over-head 110-volt circuit.

Prior to the erection of these signs, which, by the way, may be moved about, it was necessary to keep two or three policemen on duty at the center of the intersections in order to prevent collisions.

President Wilson 'Phones Message to Boys' Club

The Boys' Club, located in New York City at Avenue A and Tenth street, had what might be called, without a doubt, a "large size" evening on Jan. 17 last, when over 200 newsboys who were campaigning for a half-million-dollar fund for the erection of clubhouses listened to a talk by President Woodrow Wilson in the White House at Washington through the medium of a long-distance telephone and a number of multiple receivers.



Photo Copyright by International Film Service.

At the Boys' Club, New York City, When President Wilson Talked to Them Over the 'Phone from Washington.

The boys were so delighted by the President's words of encouragement that they cheered him to an echo over the 'phone, and he was highly pleased by this ovation. The lads who heard the President had been invited by the club from the streets of the East Side of New York; many of them were newsboys with hands blue from the cold, with torn clothing and heavy, ill-fitting shoes. They were gathered behind desks arranged in a large square in their gymnasium, their begrimed faces glowing with the enthusiasm of the moment, their hearts beating furiously as they listened for the first words of the President's talk. All of these boys are to be beneficiaries of the campaign carried on to raise the sum of $500,000 for new clubhouses in Greater New York.

This was the President's address: "I am very glad to have this opportunity to address a few words to the boys. I hope with all my heart that you will have success in raising this fund to be devoted to the youth of America. I hope this may be only the first of the signs of friendship that all ought to feel for the boys who bring us our papers. My sympathy has always been with the newsboys. Please give them all my very best wishes."

Behind the boys who held the receivers were several hundred other members of the club. The smallest lads were given the preference at the receivers, but while the President spoke many receivers were passed back into the crowd to give others an opportunity to hear. The doors of the clubhouse were closed and locked at 8 o'clock. Outside the street was black with youngsters who could not gain entrance. They took the cheering up after the President had talked and for several minutes Avenue A was filled with lusty shouts, the like of which had not been heard in that locality in many a day.

Long live the telephone, the annihilator of distance and the gift of science to mankind which has made it possible for gatherings such as this to hear and enjoy a speech by such men as President Wilson, although they may be located hundreds or even thousands of miles away. It is now a common occurrence for club diners in New York to listen to speeches made in San Francisco, and vice versa. For these occasions special equipment is installed by the local telephone company, including a sufficient number of multiple receivers, so that each guest can hear the speech.

NEW WIRELESS TO ALASKA.

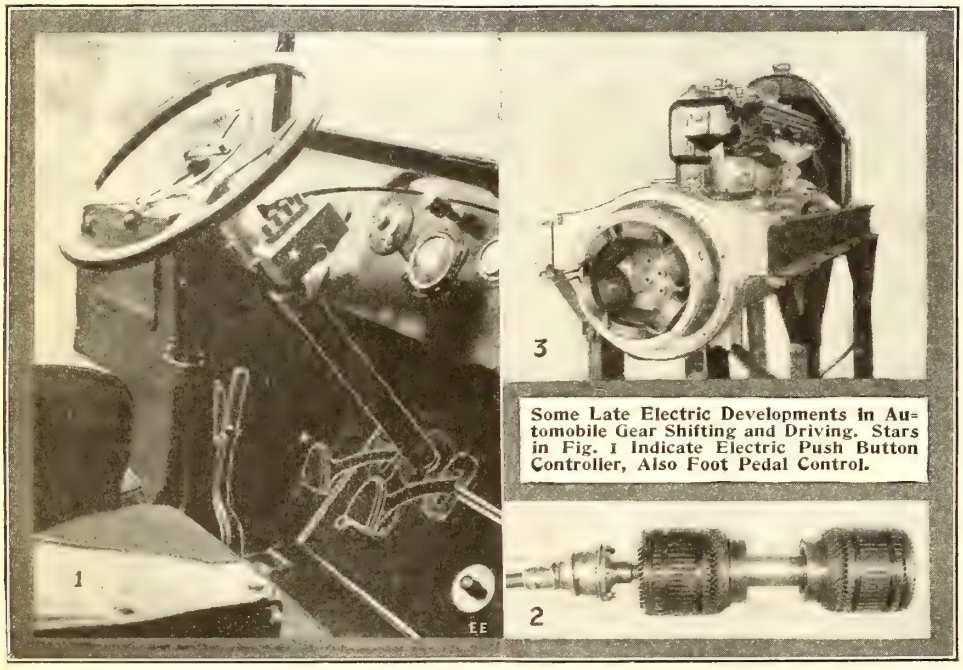
For years the only telegraphic communication with Alaska has been by way of the Sitka-Seattle and Valdez-Sitka cables. The growing commerce between Alaska and the States has resulted, as stated by H. Brown, commercial superintendent of the Western Union Co., in the establishment of an alternate wireless route by way of Astoria, Ore., which furnishes a telegraphic connection with a number of important points in Alaska.

Why not become a regular reader of *The Electrical Experimenter?* Subscribe to-day! It will cost you but $1. Do it *now.*

Electricity Fills Important Rôle in Modern Automobile

THE automobile of to-day is rapidly coming to the point where everything in the operation of same will be controlled by a series of push buttons. We light the headlights, start the motor, or blow the horn by merely pushing the proper button, and now by means of the device illustrated at Fig. 1 we even shift the transmission gears. Instead of the usual wrist strain and noisy grating of the gear teeth that used to accompany any change of speed we merely select our speed, push the button and a touch of the clutch pedal does the rest.

This system is operated entirely by electricity and all the gear shifting done in the gear case by means of magnetic solenoids energized from a storage battery. Each of the solenoids is connected to its respective control button, mounted on the steering column, and a master switch is controlled by the clutch foot pedal. The switch here illustrated has three speeds forward and one reverse, which is sufficient for most ordinary work.



Some Late Electric Developments in Automobile Gear Shifting and Driving. Stars in Fig. 1 Indicate Electric Push Button Controller, Also Foot Pedal Control.

The operation of this apparatus is as follows: When the proper button is pushed it closes the circuit to the solenoid, which will throw the gears into the required position. The clutch pedal is depressed and when released closes the master switch, which throws an enormous current into the solenoid for a mere fraction of a second. The change of gears is accomplished so quickly that they mesh cleanly without a clash or any damage. This saves both the driver's temper and the cost of stripped gears.

It will be thought that nothing more could be devised in connection with the gear transmission, but in Figs. 2 and 3 we show a transmission mechanism which does away entirely with the necessity of a gear shift and yet gives a finer regulation of speed. R. M. Owen & Co., to whom we are indebted for the illustrations, call their car when equipped with this device "The Car of a Thousand Speeds."

This system of electrical transmission is as unique as it is flexible and consists of a generator, motor, storage batteries, resistance coils and controlling switches. The generator field is rigidly connected to the crank shaft as shown in Fig. 3, and the armature is connected to the driving shaft. The motor field is stationary and its armature, like that of the generator, is rigidly connected to the driving shaft as illustrated in Fig. 2. Thus it is evident that the generator field is revolved at engine speed, and both generator and motor armatures revolve at wheel shaft speed. The motor and generator are direct current machines; the motor being series wound, while the generator is shunt wound. This arrangement necessitates the revolution of the generator brushes at the same speed as the field. In order to deliver current to the brushes of the motor they are connected to slip rings, this same device being used for making connections with the field.

The complete system operates as follows: For cranking the generator is energized by current obtained from storage batteries, causing it to act as a motor, thus starting the engine in the same manner as the commercial motor starter now extensively employed. For starting the car a resistance is connected across the field of the generator, and as the magnetic flux builds up the field exerts a *torque* on the armature and turns the driving shaft and consequently starts the car. The resistance in the field is then cut out and short circuited, thus more current flows in the fields increasing the flux and exerting a greater torque on the armature which accelerates the car. The generator is constantly producing current due to the difference in speed of its field and armature. This current is led into the motor, which exerts a torque on the driving shaft and helps the generator to drive the car. To further increase the speed resistance is switched into the motor circuit, thus throwing more current through the field of the generator, which thus tightens its grip on its armature and decreases the *slippage* between the armature and the field. Successive resistances are cut in until practically there is no current drawn from the generator. The motor is then cut out of circuit and the generator armature feeds the fields only. The generator now acts as a magnetic clutch, the current necessary to energize is produced by a slight slippage between its armature and field which amounts to about 10 per cent. This slippage is sufficient to generate enough current to transmit 40 or 50 horsepower through the apparatus with high efficiency.

This may not seem possible, but it must be remembered that the slippage between the generator's field and armature has been decreasing as the car is accelerated, so that the relative speed of field to armature is small when this connection is made. With this small relative speed the armature reaction is not great enough to break down the torque. In this condition a point of equilibrium is reached where the slip is just sufficient to generate enough current to maintain the magnetic grip. The operation is analogous to that of the induction motor, in that an increase in load is balanced by an increase in slippage. If a grade is encountered the slip increases and because of this a greater torque is exerted on the driving shaft, due to the additional current generated.

All these operations are controlled by an extra lever situated on the steering wheel, thus eliminating the clutch pedal and gear levers. There is no flywheel, as the generator field acts as such. A mechanical brake is also provided, but this is not used except when it is necessary to bring the car to a sudden or dead stop. If the controlling lever is thrown to the neutral position when the car is running at high speed a resistance is thrown in series with the motor, which develops a torque that tends to stop the car. This brake will not bring the car to a dead stop as its braking power depends on the car's motion, but it is very useful in keeping down the speed.

The storage batteries are charged from the motor, which contains an auxiliary field that furnishes current to the batteries when it is on high speed. These batteries are used for lighting purposes.

With these rapid advances in the electrical equipment of automobiles we may safely predict that the car of the near future will not only be started, lighted and its speed controlled by electricity, but it will be steered by this willing servant of man. It will require no more effort to drive a powerful racing car than it does to call a waiter. The control of these machines will be so simple that a five-year-old child can handle one with ease.

NEW ELECTRICAL MANICURE.

Los Angeles ladies are having their nails manicured by electricity. It's the latest method of beautifying the hands. Pink powders and polishers are unnecessary on milady's toilet table, for the same electricity which has been harnessed for great industries does its little turn in milady's boudoir and polishes dainty fingers.

Mrs. F. A. Scott, of Los Angeles, who conceived this latest device for manicuring and beautifying, declares it trims, files, cleans, smooths and polishes the nails in a most sanitary, businesslike way.

B-r-r-r! and one's nails are filed and cleaned by a little whirring machine. A faster revolution and the nails are polished with a shine that won't come off—a shade pinker than seashells. A third pressure of the button, a louder b-r-r-r and a splash of toilet water, and the work is done. Why don't someone invent a machine to give the male of the species a shave, a massage and a hot towel automatically, and finally to release the "hat" without the everlasting "tip!"

Do you enjoy this magazine? If so, tell others. If not, tell us. Remember we publish it to please our readers.

Marvels of Modern Physics

By Rogers D. Rusk

Assistant Instructor in Physics, Ohio Wesleyan University

SOME MISSING LINKS.

IT is just as important that the scientific man should know about the stumbling blocks of science, as that he should have a well ordered knowledge of the facts and laws already determined.

Man has perplexed his mind with many difficult questions. In the physical field alone he has asked himself: Is space infinite? What constitutes matter? How does gravity act? What is electricity? Etc., etc., ad lib., ad infinitum.

Ages of weary labor have been expended on these problems with the result that we are hardly nearer the direct answers than we were before. Some of the blanks seem likely never to be completely filled, but at least we know more extensively and accurately concerning them and the phenomena to which they are related.

Most of the puzzle questions of the scientists have not been practical and worth while, however. It has hardly been 500 years since scientists were loudly wrangling over such frivolous and absurd questions as, "How many angels can stand on the point of a needle?"

It was in the midst of these absurdities that Roger Bacon made his remarkable prophecy in the thirteenth century, in which he predicted the coming of the steamboat, railroad and aeroplane. His prophecy is the more remarkable coming from such an age, but unfortunately he added that the fountain of youth would be discovered and the baser metals changed into gold. Like perpetual motion they have always proved to be the phantom at the end of the rainbow.

To-day, excepting, of course, the absurd and impossible, there are still many missing links in our chain of knowledge.

Some years ago Physics was defined as "the science of matter, ether and motion." These terms at once suggest to our mind three of our big *Unknowns*.

The last two of these will be treated of in this article, while the subject of matter and its constitution will be taken up separately later.

With reference to motion, the different kinds are pretty well known and understood. Of course many perplexing questions can be asked such as: "How can the top of a cart wheel move faster than the bottom?" and, "Can Achilles ever overtake the tortoise?" but these are more mathematical than physical problems.

Two of the forces which cause motion, however, are much less well understood. They are gravitation and magnetism.

Isaac Newton is popularly accredited

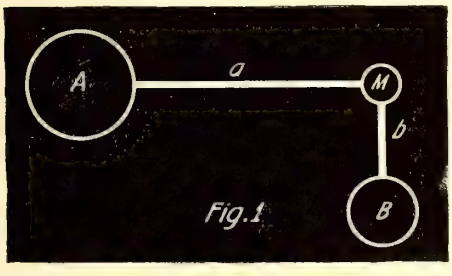


Fig. 1. Diagram Showing the Relative Pull of the Earth "B" and Sun "A" Upon the Moon "M."

with the discovery of the attraction which causes bodies to fall towards the center of the earth. Notwithstanding the familiar story of Newton and the falling apple, this force must have been recognized as a common fact long before his time. What Newton really did was to discover the universal law by which the force acted, and not the force itself.

This law—the universal law of gravitation—states that: "Every body in the universe attracts every other body, with a force that varies directly as the product of the masses and inversely as the squares of the distances."

This, of course, was a startling statement of the fact that the force we commonly term gravity is in reality a universal force acting between all bodies, and that it is only because the earth is so very large that it does not fall to the apple instead.

For a long time it was the pet dream of the more fantastic minded to discover a force of "negative-gravity" which would counteract or neutralize gravity itself, but the discovery of such a force seems quite far away indeed.

Newton's' law of gravitation brought out many interesting experiments. The sun,

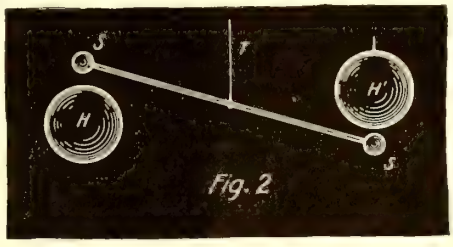


Fig. 2. The Famous Cavendish Experiment for Determining Relative Gravity Values.

moon and earth have each been weighed (a seemingly difficult task) by an application of this law. If in the diagram, Fig. (1) "A" represents the sun, "M" the moon and "B" the earth, while "a" and "b" rep-



Fig. 3. Illustrating Mechanically a Sphere Containing Opposite Electric Charges.

resent their respective distances of 93,000,000 miles and 240,000 miles, then the ratio between the relative pulls of the earth and sun upon the moon works out to be about $\frac{120}{54}$. This makes the sun approximately 300,000 times the mass of the earth.

Now to find the absolute weight of any of the bodies, the weight of one must be found before the proportion can be formed.

This was done by Cavendish in 1798 in his experiment which has since become famous. He definitely measured the attraction between a lead sphere 12 inches in diameter, weighing 350 pounds, and a smaller sphere two inches in diameter, weighing one pound and ten ounces, and also the attraction of the earth for same. The previous problem was really repeated by Cavendish substituting two lead balls of known weight for the sun and moon. Thus the earth with its thirteen billion billion pounds was actually weighed. In Cavendish's apparatus, in order to double the effect, two large spheres were used, and likewise two small ones. These are represented in Fig. 2, and the small ones as shown were connected by a light bar and

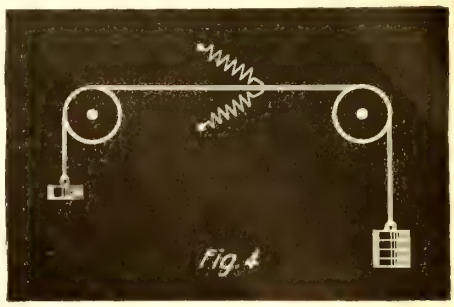


Fig. 4. Mechanical Analogy of Electric Strain Existing in a Charged Leyden Jar.

suspended by a thin silver wire. The amount of twist of the wire was then a measure of attraction between the spheres.

Many theories as to the nature of the force of gravitation have been presented, but the only theories which seem at all reasonable or possible imply the existence of some invisible and intangible medium which exists throughout all space, and permeates all matter; which exists between the heavenly bodies, beyond the limits even of any atmosphere.

In following this line of thought we are treading exactly in the footsteps of the older scientists, beginning with Newton.

Little of a definite nature was done with reference to the establishment of such a theory until 1678, when Huyghens, perceiving that light traverses a vacuum unimpeded, decided that it must have some medium to travel in or on. Also, as light comes from the sun, and even from the most distant stars, this medium must indeed be infinite in extent. Earlier theories of light had miserably failed, but Huyghens formulated his theory that light is nothing material, but that it is a wave motion in some invisible medium, which medium we call the *ether*.

Wonderful to relate, this theory, with the exception of a slight modification along electro-magnetic lines by Clerk Maxwell and others, is the accepted theory of today.

The development of our theory of the ether has been the biggest unifying factor in the history of modern physics. It has brought the different branches of physics in close touch, and paved the way for wonderful future progress.

There is little more to say concerning gravitation until we have considered the ether further.

Is the ether material or not? Matter is that which occupies space, but the ether does not occupy space in the ordinary sense of filling space. It is intangible and imponderable, therefore we say it is not matter; but on the other hand if matter is that which *exists*, and has certain physical characteristics, then ether may well be classed as matter. The horns of the dilemma are obvious.

Some years ago the ether was characterized as continuous (not composed of unit particles), infinite in extent, infinitely elastic, frictionless and without weight.

Sir William Thompson, however, made the interesting calculation, dependent on the displacement of a particle of ether in

(*Continued on page* 665.)

Baron Münchhausen's New Scientific Adventures

By Hugo Gernsback

The Cities of Mars

MANY of our astronomers have noted from time to time that immense sandstorms frequently sweep over the face of the Planet Mars. As such storms seem to cover vast areas it would appear that the sand must of necessity be rather light to float in the thin Martian atmosphere. For this reason, it is reasonable to suppose that the sand is extremely fine—dust in other words. But how can intelligent beings live permanently in an atmosphere loaded with fine dust? This instalment advances a new idea how the Martians may make life bearable on their desert planet.

IF there is one thing that annoys me, it is a nosey reporter. To be sure, they are harmless folk, are reporters, and suave and well-mannered as a rule, too. But somehow their eyes always appear to me as gimlets and their noses as huge corkscrews, but then those are the characteristics of the tribe, and really they can't help it. It is their business to drill holes right through your mind, and once their corkscrew noses have dug themselves into your confidence they pull and pull till something comes up. A reporter can always dig news out of you, even if there's no news to be had. All of which might be of interest to you, and then again it might not. At any rate, the editor of the Yankton *Bugle,* who has heard about Münchhausen, sent a reporter to my laboratory in order to "write me up" and to find out if Baron Münchhausen was fiction or truth. Not that it was the first time that this particular reporter had called in vain. For I have a deep-seated aversion against the *Bugle,* which aversion includes everyone from the editor down to the job press. Hence I wasn't "in" to reporters heretofore. But on this occasion the reporter, who is a live one, succeeded in running the blockade. He "made up" as a water meter inspector, and as both the water meter, as well as my wireless station, are located in the basement of the house, he had but little trouble in "torpedoing" me. Once established in a chair there was nothing to do but to submit to his tortures.

Of course, he did not believe that there was such a thing as Münchhausen, who was supposed to live on Mars just now and who was supposed to send nightly wireless messages to earth, which are relayed to me from the moon by an alleged relaying plant located there.

However, the reporter was willing to obtain first hand evidence for his paper, and if I did not object very much he would stay till 11 p. m. in order to "listen in." To strengthen the argument he pulled out some two for 50c. Perfecto's (reduced to 40c. Saturdays only at Frank Levoy's cigar store on Main street). As my Nargileh wasn't working for lack of proper ammunition that evening, the argument proved convincing and I bade the reporter, whose name was Bill Snickles, to make himself at home. I explained to him all the good points and qualities of my wireless, and after the second Perfecto I was willing to let him photograph the station. He called up the office for the staff photographer, and after the flashlight had been taken it became time to adjust the instruments. In another three minutes Münchhausen would be calling. I had placed an extra set of 'phones on Snickles' head and I could see that he was breathing hard with suppressed excitement. I had keyed him up to such a pitch that when my chime began striking the first stroke of eleven he jumped clear out of his chair. But I smiled a very superior, benevolent smile at him, as a father smiles at his uncomprehending babe. I then leaned back comfortably, toyed a bit with the Harmonic Ultra-Amplifier, adjusted the Selenium Vapor Enforcer, and turned once more the knobs of the coupled inductance balancer to make sure that I was tuned in for 90,000 meters—the wave length used by Baron Münchhausen.

The chime had sounded its last stroke. In another second the dear old gentleman's voice would greet me as usual.

Have you ever wished to "show off" to your friends or to your relatives and the "show off" failed to materialize? Have you ever experienced the cunning feeling of an icy cold wave racing up and down your spine, to be followed immediately by a hot blast up and down the self same spine? And has the perspiration broken out all over you at the contemplation that the "show off" was a fizzle? Yes? If you have, you know exactly how it feels.

At 11.05 p. m. I began to wonder why it was so hot in the room. By 11.10 p. m. I was taking a Turkish bath. By 11.20 p. m. I calculated that my private temperature must have gone up to somewhere near 269° Fahrenheit, rising steadily all the while. By 11.30 p. m. I wasn't sure whether I preferred calling an ambulance or jumping into the ice covered pond in front of the house.

Münchhausen simply didn't "call." What was wrong? Why had he failed me for the very first time, just when I could least afford it? For the first time since I knew him I felt bitter toward him. What had happened?

And there was Snickles with a sarcastic grin spread all over his bird-like face, making biting remarks all of the time.

"Maybe the ether gave out, what?" he mocked. Or: "Maybe Münchhausen has a Martian frog in his throat and can't talk!" Or else: "Isn't it possible that the message became lost in transit? In that case I would suggest that you put an ad in the *Bugle's* Lost and Found co....."

That was the last straw. He didn't finish the sentence and he didn't wait to take his hat either. He went out like a blue streak, with me at his heels. But reporters, among other accomplishments, must be good runners. He is. At any rate, I did not catch him. Disgusted and in a white rage, I went to bed.

My ruffled feelings were not particularly smoothed next morning when my young brother brought me a copy of the *Bugle* while I was still in bed.

Snickles had certainly outdone himself. The whole town would choke with merriment when they would read the account, there was no doubt about that. The headlines were enough:

I. M. ALIER MAKES STUPEFYING INVENTION.

RECEIVES SOUNDLESS, VOICELESS, MESSAGES FROM MARS.

ALLEGED HERO, MÜNCHHAUSEN, SPEECHLESS WITH SURPRISE.

MÜNCHHAUSEN SAYS HE AIN'T SAYIN' NOTHIN'!!

And so on, and so forth. The article was written so excruciatingly funny that I had to laugh myself, despite my rage. But the laugh froze to ice when my eyes had passed over the line where Snickles had written ironically:

"Undoubtedly Münchhausen was asleep at the switch!"

With one bound I was out of bed and was racing madly down to my wireless station barefooted. I gave one look at the lightning switch in the corner of the room and almost collapsed:

The switch was grounded and had been grounded since noon of the previous day!

For you may know that the Fire Underwriters nowadays require wireless stations to have lightning switches in order to protect the building from lightning. Thus when your station is not in use you simply connect the aerial to the ground by throwing the switch, and no damage can be done by a thunderbolt. Not only that, but in this condition the aerial becomes really a first class lightning arrester.

Sad to relate, however, certain idiots are apt to forget to throw the switch over when trying to receive messages, I being among them that evening. For when the reporter called so unexpectedly I forgot all about the switch and never bothered to look around to see in what position it was.

Münchhausen had called, of course, of this I was certain. The message, however, had flown from the aerial directly to the ground, never entering my receiving instruments Lost and lost forever! And my thoughtlessness had made me the laughing stock of the town on top of it! It was maddening. Right then and there for the next ten minutes I had what my little sister very appropriately terms as a series of rather violent "conniption fits!"

* * * * * *

That evening promptly, as always, Münchhausen "called." He did not waste much time in preliminaries, but went right to the point:

"Alier, my dear boy, I can't begin to tell you how wonderful this planet Mars is with all its marvelous inhabitants. Flitternix and myself are as in a trance half of the time. Our brains simply cannot digest all the thousands of wonders we see around us every minute. For a poor untrained human mind to be suddenly transplanted into a civilization hundreds of thousands of years ahead of terrestrial civilization is no easy matter. At times we are positively numb with astonishment and the more we see and learn the less we feel we know. Every new marvel opens up a dozen new unfathomable avenues, each one equally puzzling.

"But to proceed. Yesterday I explained

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to you how we had our first Martian meal at our host's residence and how we experienced that gaseous food that you don't need to chew, is vastly more nourishing and satisfying than solid food. It does not overload the stomach as do solids and the digestion is vastly improved. The gases liquify, of course, in the stomach, but the latter itself never becomes distended. Besides, the Martians, trained rigidly from earliest childhood, know just how much gaseous food they can assimilate. This, I understand, is one of the reasons why the average Martians live over 150 Martian years, which is 300 terrestrial years.

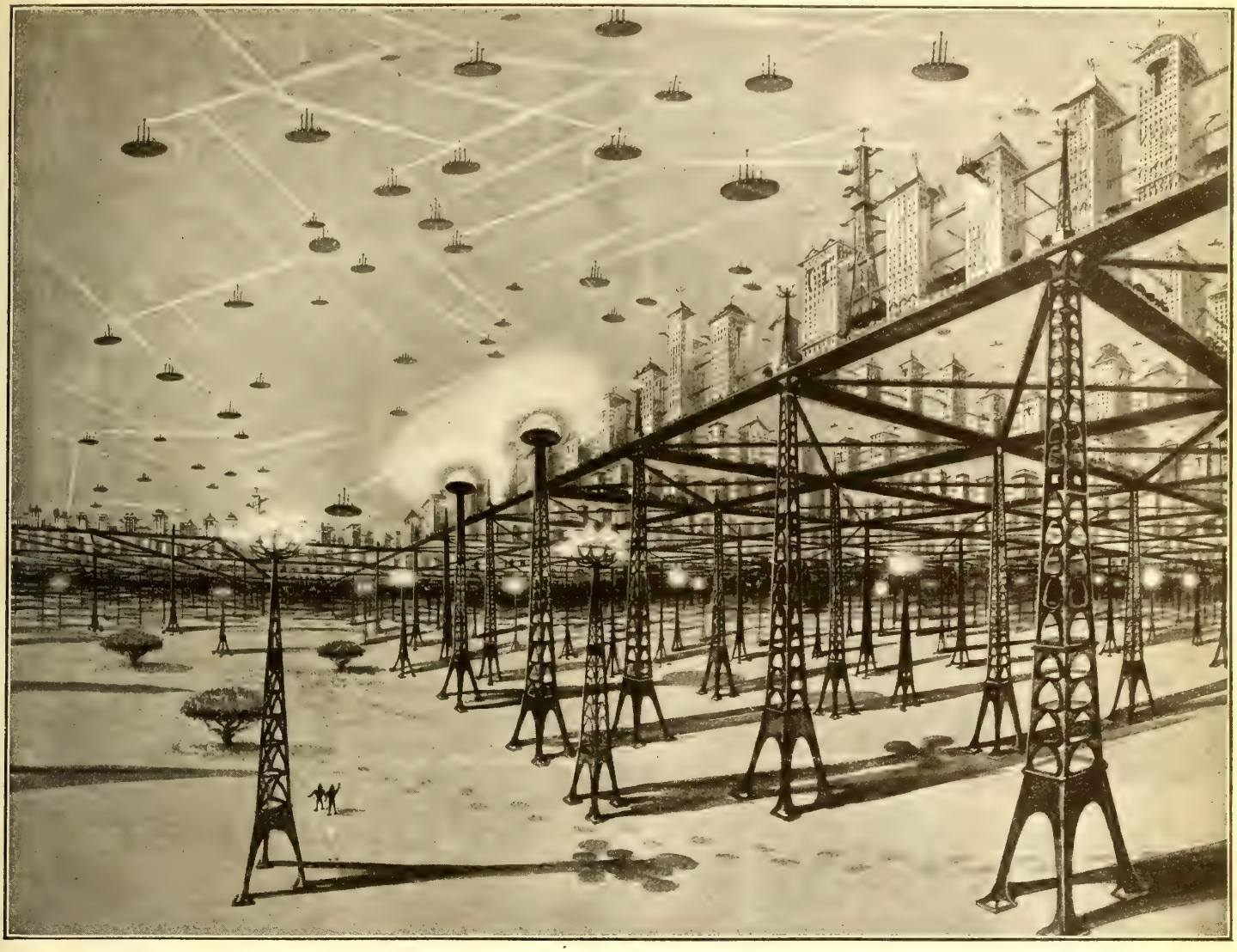
"After dinner we were conducted to the roof of our host's mansion, where we made ourselves comfortable in the large transparent chairs scattered around beneath a cool, green, silky-appearing canopy. As I mentioned to you previously, the Planet Ruler's mansion resembles somewhat a colossal cathedral. The roof is about 250 feet from the ground and the entire structure rotates slowly around on its axis. This is the reason: While the Martians are enlightened enough to have no religion whatsoever, they know what we have known for some time, namely, that life on all planets is absolutely dependent upon the sun. Extinguish the sun to-day and all the planets throughout our planetary system from Mercury down to Neptune will become dead worlds. Without sunlight the rivers will cease flowing within three weeks. Within six months all waters on earth and Mars will have frozen down to the bottom. The vegetable kingdom will have ceased long before that and the animal kingdom, dependent upon the vegetable kingdom, will die even a more rapid death. In less than two years the last surviving human on any of our planets will have ceased living. There can be no organized life as we know it without the direct influence of a live sun.

"While the Martians are by no means sun worshippers, they nevertheless have a deep-rooted feeling for our luminary. This is strikingly illustrated by the fact that the Planet Ruler's mansion is constructed in such a manner that powerful machinery revolves the entire structure silently during the entire Martian day; the first rays of the morning sun thus shine into the Ruler's private rooms, and as the sun keeps on rising the house keeps pace and thus the entire day till the last sun ray creeps over the western horizon, the Ruler's windows are bathed in sunlight. During the night the house does not revolve.

"The day we were on top of the Ruler's mansion was still our first day on Mars. It was then in the early afternoon, after lunch time, as mentioned before.

"Down below we looked upon the 'city,' which seemed to be laid out in form of a vast semi-circle, as far as we could ascertain. To the west we could just glimpse one of the water ways.

"We stepped to the balustrade and peered down, completely stupefied with what we saw. But Flitternix, his mind full of astronomical observations, called my attention to the heavens and I followed his command reluctantly.



"It was found that the ordinary desert dust did not usually rise higher than 400 feet above the surface of the planet. For this reason all buildings and structures on Mars, with few exceptions, are located 500 feet above the ground. . . ."

"'You will observe,' said he, pointing at the sun, 'that it appears quite a bit smaller than when seen from the earth. It also does not appear yellow-white, as it looks to terrestrial inhabitants. You will note it has a rather reddish hue; that is because we are now a good bit further away from it, a matter of over 60,000,000 miles further than on earth. In other words, we are now twice as far away from the sun as we are on earth. But you must have observed how warm it is everywhere on Mars, as far as we have visited it, and that the day appears fully as bright, if not brighter, than on earth. Naturally you will wonder, for on Mars, as well as anywhere else in the world, certain physical laws hold good. Thus heat and light diminish inversely as the square of their distance, in other words, a 16 candlepower lamp two feet away gives only one-quarter the light (four candlepower) of the same lamp if seen at one foot away. Heat acts in exactly the same manner. Then why is it that the day is as bright, and the heat as great as on earth, although we are twice as far removed? According to the physical law just mentioned Mars should only receive four-ninths of the light and heat from the sun as does the earth. Why does it receive more? Early astronomers on earth rea-

(*Continued on page 658.*)

The RADIO LEAGUE of AMERICA

HONORARY MEMBERS
CAPT. W.H.G. BULLARD, U.S.N. NIKOLA TESLA.
PROF. REGINALD FESSENDEN. DR. LEE DE FOREST.

Manager, H. Gernsback

How to Organize and Conduct a Radio Club

WITH the advent of The Radio League of America, the details of which organization were given in full in the December, 1915, issue of *The Electrical Experimenter*, there has been opened up a wider and more promising field than ever before for the formation of subsidiary or local radio clubs throughout the country. Given the proper spark of enthusiasm, there is no city or hamlet too small in the whole United States but what it could support one or more such radio clubs.

Possibly you, as a radio enthusiast, even though you may not have a very elaborate wireless station (either for receiving or transmitting, it matters not), have often thought it would be a fine idea if you could band together several other similarly interested persons either from an experimental, scientific or amateur standpoint.

Preliminaries.

To start a radio club or society there are several methods which may be employed to aid the formation of such. One of the first things that can be done is to write a letter to the manager of the Radio League of America stating briefly your intentions and desires, at the same time asking for the names and addresses of any other radio amateurs in your particular locality. Upon receipt of this information you can then either visit the experimenters personally or a very good scheme is to write each a letter, explaining your ideas and suggesting a date for a meeting at which the matters pertaining to the formation of a local radio club can be talked over.

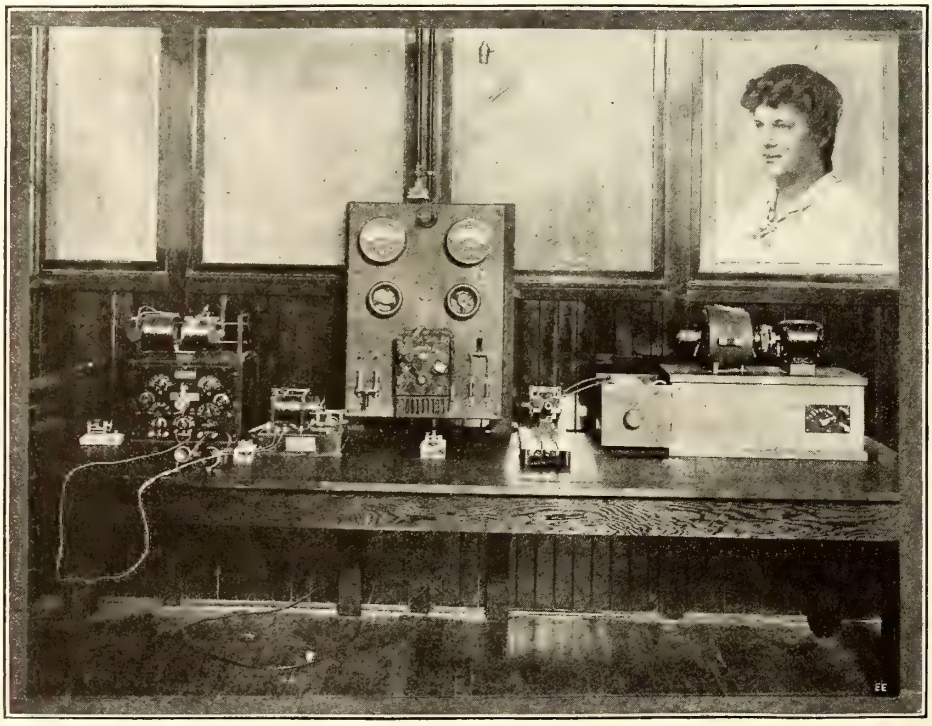
In some cases such organizations are formed and many details of the work are finished *via wireless*, as, for instance, when the "organizer" has a radio transmitting and receiving station so that he may call up other amateurs by noting their call numbers in the regular Wireless Call books. Still another scheme which can be followed out in many such cases, and also at an insignificant cost, is to insert an advertisement in your local newspaper, stating that the advertiser would like very much to have all those interested in experimental wireless telegraphy call at his residence on an appointed evening for the purposes set forth.

One of the first things that has to be considered after a response has been had to such an advertisement or other campaign as aforementioned, is the rules of order to be followed in forming the organization. It may be said that many small clubs do not go in for the deeper legal rules usually governing such bodies. The appointment of an inspector or engineer as one of the officers, together with the president, vice-president, secretary and treasurer (the two latter officers are very often combined) suffice for all practical requirements.

It is a very good idea to select a capable member to act as consulting engineer, and whose duties shall cover the visits to each member's station for the purpose of checking up his wave length, deficiencies in operation of the apparatus, etc.

Maintaining Interest in the Club.

Once the radio club has been formed, it is not always an easy matter to maintain the interest in same by the members. A good leader in any event will help to overcome this trouble to a large extent, but of course he must be aided in every way by the other officers of the club. One of the first important things to be done when starting a new organization is to select for the first few meetings, at least, some particularly good wireless or allied papers. They advisedly should not be of too technical a nature, as it may discourage some of the younger members or others who are not so far advanced in the science. A good suggestion in this direction is, whenever possible, *try to obtain the services of an instructor in radio operating and engineering from a local school or college*, who in most instances will be only too glad to make a short address at any time, before such an organization.



The Very Fine Radio Equipment of the Minnesota Wireless Association, Minneapolis, Minn. Insert Photo Is That of Miss Aline Mengelkoch, a Radio Enthusiast, Who Often Operates the Set Here Shown.

A letter of the proper sort, addressed to such men, will invariably result in their acceptance of your proposition. It will be readily seen that a greater impetus will be given the club if such speakers are engaged at least for the first few meetings. A case in point is the Radio Club of America, with headquarters at New York City. This organization has been coming to the front very rapidly in the past two years. Many of the speakers at the monthly meetings are some of the leading instructors and engineers in the wireless profession; men who also address meetings of the Institute of Radio Engineers, which body is, of course, the foremost scientific radio organization in the world, counting among its members the leading wireless engineers and scientists of all countries. The office of the secretary of the Institute is at 233 Broadway, New York City. The monthly meetings are held on the first Monday of each month in Fayerweather Hall, Columbia University, New York City, at 8 p. m. This Institute publishes its proceedings, containing the more important articles presented at the various monthly meetings, four times a year; that is to say, the proceedings come out quarterly and form a most valuable addition to any radio operator's or engineer's library. The dues for an associate membership are $4 a year, and so far the Institute has managed to publish its proceedings and defray its other incidental expenses with but little extra financial aid from a few of the members.

It is not intended to dwell upon the features of such an extensive body as that now under discussion, but it may be said that while the interest among the members has flagged at different times, notably several years ago owing to the great shake-up in the business affairs of several commercial wireless companies, etc., it should be said that those managing the affairs of this organization have always kept in mind the point previously mentioned, i. e., that it is best to obtain the services of the very best speakers and lecturers in this line whenever possible.

The small radio clubs just forming, however, need not feel discouraged if they cannot obtain a speaker of prominence or great learning to address them, as in many instances there are one or more energetic and capable radio men among their own members who will probably in many cases

prove better as leaders for such bodies of youthful experimenters than a more mature individual of more advanced and professional inclinations.

Club Dues.

Speaking of club dues, this is an important point. As many of these societies meet at the members' houses, there is then no rent to be considered. The smaller clubs, of course, can run along quite nicely with but a small budget or expense, except that necessary for buying stationery, having cards or literature printed, etc. For the younger clubs, composed of members between the ages of 12 and 15, the dues should not reach much above 25 cents a month. But with clubs made up of older members than those just mentioned and having club quarters for which rent must be paid there will, of course, have to be a higher monthly due levied. Most of the larger organizations have an entrance or initiation fee of perhaps $1, but this, of course, will have to be considered and worked out by the officers in charge of the affairs of the club. This factor will vary in the different localities and with the different classes of members.

Investing in the Club.

While it is not desirable in any event to work hardships upon the members of the radio clubs, it should be borne in mind by the officers of such that the organizations enjoying the greatest popularity are those in which the members are very vitally and personally interested. This comes to the point of having each member invest in the club, which may be brought about by bringing the propositions before the organization at one of the regular meetings. A great many of the societies to-day have excellent wireless sets maintained at the club quarters and, of course, in this instance the rooms are invariably open every day, or at least every evening, so that those members who so desire may come to the rooms for practice or training in the handling of the radio apparatus. There should be a chief operator appointed, and also when occasion demands it, someone who shall be responsible for the proper maintenance of the wireless set.

It is best to choose a fairly good wireless transmitting and receiving set, which can, of course, be had at all prices imaginable, say from $10 up, and even for a lesser amount when the club is a small one.



Excellent Wireless Exhibit of the Atlanta Radio Club, of Atlanta, Ga., an Example of What a "Live" Organization Can Accomplish.

In this direction we would like to call the reader's attention to the excellent photographs reproduced here and in other forthcoming issues of *The Electrical Experimenter* showing what can be accomplished by a good, "live" amateur wireless organization.

In the first illustration we wish to mention the excellent wireless set owned by the Minnesota Wireless Association, of Minneapolis, Minn. Particularly in this connection we wish to call attention to the excellent work accomplished on this outfit by Miss Aline Mengelkoch, whose picture is observed in the upper right corner of the illustration of the station. Miss Mengelkoch is very enthusiastic about wireless telegraphy and is said to be the youngest commercial woman operator in the United States, she having just received a first-class Government radio operator's license. She can transmit and receive messages at the rate of 35 words per minute and, moreover, is widely read on the subject of radio telegraphy.

This is a good matter to keep in mind in club affairs. Do not forget your sister or girl friend who may have scientific inclinations. Get her to join the club, as there is a wide field open, indeed, for wireless experts, and the excellent work of Miss Mengelkoch before cited, as well as that of several other women operators, proves that she can engage in this field as successfully as in any other.

While on the subject of amateur wireless clubs that are doing big things, we would call attention to our illustration which represents the excellent wireless exhibit conducted by the Atlanta Radio Club, of Atlanta, Ga. The address of the vice-president of this club, R. A. DeVore, is 19 Second avenue, Oakhurst, Atlanta, Ga. It is really wonderful to contemplate the achievements of this organization, which was started but little over a year ago. It has received many congratulations on the exhibit which it arranged and which formed a part of the recent Electrical Show held in Atlanta.

The exhibit attracted great attention. One of the most interesting features, perhaps, was an exact replica of the first Marconi wireless set, complete with induction coil and coherer. Near this was a complete sending and receiving set of modern type, owned by member of the club, with which bona fide radio messages were received and transmitted. The visitors to the show were given popular lectures by members of the society on the theory and practice of wireless telegraphy, and, together with practical demonstrations, they were made to appreciate the rapid strides made in radio work the past few years.

The Electrical Show was held on the ground floor of a large office building, upon the roof of which was erected an aerial, the height of which was nearly 200 feet and the total length 400 feet.

Another point of interest was a table 5 by 15 feet, completely covered with send-

(*Continued on page* 664.)

REVISED LIST OF AMATEUR RADIO CLUBS

Akron Radio Club, 760 Damon place, Akron, O. Secretary, A. A. Crum, Radio department, G. T. & R. Co., Akron, O.

Amateur-Scientists, Public School 66, room 256. Secretary, Harry Fienberg, 124 Amboy street, Brooklyn, N. Y.

Amateur Marconi Radio Association, 614 Fifth avenue, Troy, N. Y. Secretary, D. Malcolm Williams, 1627 Seventh avenue, Troy, N. Y.

Bradentown Radio Club, Stockbridge avenue, Bradentown, Fla. Secretary, Hughson Hurlebaus, 439 Main street, Bradentown, Fla.

Carrollton Radio Intercommunication Club, Fifth Street Public School. Secretary, Stuart W. Pierson, 214 Maple avenue, Carrollton, Ill.

Chicago Wireless Association, room 1010 Lake View building, 116 South Michigan avenue, Chicago. Secretary, Frederick D. Northland, 24 Scott street, Chicago, Ill.

Colorado Wireless Association, 600 Y. M. C. A. building, Denver, Col. Secretary, L. P. Hough, 600 Y. M. C. A. building, Denver, Colo.

Cranford Radio Club, Cranford, N. J. Secretary, Russell Damon, Arlington road and Madison avenue, Cranford, N. J

East Night High School Radio Society, Woodward High School. Secretary, C. H. Fender, Woodward High School, Cincinnati, O.

Fall River Radio Association, Technical High School, Fall River, Mass. Secretary, Lawrence Phelan, 6 Rodman street, Fall River, Mass.

Hawkeye Radio Association. Secretary, A. B. Church, Lamoni, Ia.

Inter-City Radio Association of Allentown, Pa., Y. M. C. A. building. Secretary, William J. Kreis.

Junior Radio Club, Gregory street, Pensacola, Fla. Secretary, Oliver Williams, Pensacola, Fla.

Philadelphia Radio Association, 4810 Germantown avenue, Philadelphia, Pa. Secretary, G. S. Ballantine, 4810 Germantown avenue, Philadelphia, Pa.

Radio Club of the Polytechnic Institute of Brooklyn, 85 Livingston street, Brooklyn, N. Y. Secretary, R. G. Wehle, 85 Livingston street, Brooklyn, N. Y.

Radio Club of Union College, Union College, Schenectady, N. Y. Secretary, Edwin A. Schabbehar, 242 Union street, Schenectady, N. Y.

Rockaway Radio Club, 296 Washington avenue, Rockaway Beach, N. Y. Secretary, L. Wagerer.

The Talo Club, New York City. Secretary, Edward T. Dickey, 1649 Amsterdam avenue, New York City.

Technical Wireless Association, Washington, D. C. Secretary, Edwin D. Powell, 908 Kennedy street, N. W., Washington, D. C.

Wireless Association of Central Pennsylvania, Harrisburg, Pa. Secretary, D. H. Zorger, 409 Kelker street, Harrisburg, Pa.

Yorkville Radio Development Association, 73 East End avenue, New York City. Secretary, Joseph L. Cermak, 73 East End avenue, New York City.

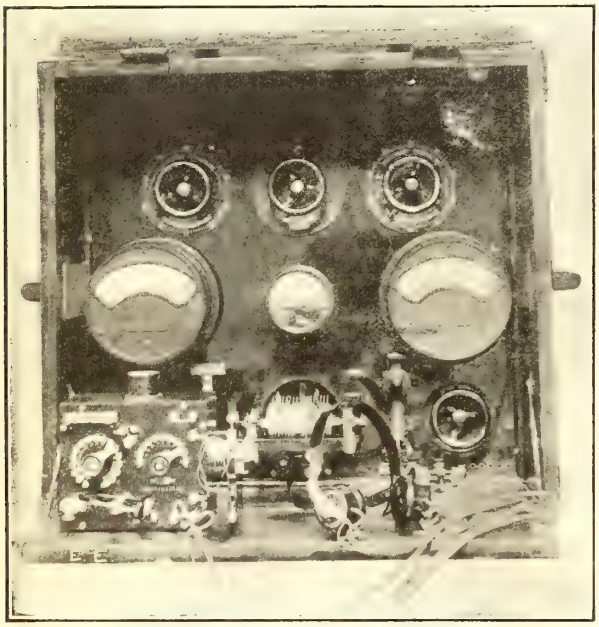
Notice: To ensure proper entry of club registrations in our revised monthly list be sure to send us at once the data outlined below. Such information should reach us not later than the 28th of the month for entry in the succeeding issue of THE ELECTRICAL EXPERIMENTER.

Name of Club .....
Location (street and city).....
Founded .....
No. of Members.....
Meeting Date .....
Power of Club Set, if any.....
Call Letter (licensed?).....
Dues and Initiation Fee.....
Secretary's Name and Address.....



New 500 Watt Military Radio Pack Set

THE wireless sets used for military purposes, and particularly those now in use by the United States army, consist of the very best instruments that can be purchased. These sets must work under every possible condition. The accompanying illustration shows one of these extra sturdy pack outfits, which at the same time combines extra high efficiency in both the transmitting and receiving ranges attained, as well as in small space occupied.



Extremely Compact 500 Watt Military Radio Set.

These sets are of the portable style, equipped with generators of the 500-cycle alternating current type fitted in a separate case, so that it is thoroughly portable and may be carried on separate trucks. The cases are unique in construction, consisting of a substantial wooden frame or base, so to speak, which is covered both on the inside and outside with a 1-16 inch layer of gray sheet fiber. This is glued to the wood under hydraulic pressure. The cabinets are protected by hard fiber angle strips riveted on and further protected from damage by iron bumpers at the corners.

The apparatus, such as volt-meters, ammeters and hot wire meter, as well as transmitting inductance control handles, etc., are all mounted on the micarta panel. The quenched spark gap of special design, perceived at the base of the panel, is cooled by a small electric fan placed behind it, so as to blow a draft of air directly over the gap. The gap plates rest in micarta guides. Their sparking surface, which is at the center, is of pure silver. This surface measures 3-64 of an inch in thickness, with a diameter somewhat larger than that of the metal plates supporting them and on which they are soldered. The silver is then spun over and riveted down.

The condenser bank for this 500-cycle transmitting set is composed of six condenser units of practically .002 micro-farad each. The resulting capacity of the whole bank, after the condensers are connected in series-parallel, is .013 micro-farad.

The step-up transformer, of the resonance type, is of the open-core pattern and is mounted within the case, back of the micarta panel containing the measuring instruments, etc. Silk-enameled magnet wire is used in winding the secondary of same, which is of the dry form, not requiring any oil for its insulation. Various transmitting wave lengths may be quickly arranged for by means of calibrated inductance control handles and scales mounted on the front of the upright panel of the set. A regular Morse key is perceived at the right of the cabinet

The receiving set is very compact and may be observed resting on the drop front of the transmitter cabinet, at the left of the illustration. The head 'phones are the well-known adjustable-magnet type supplied to the United States army and navy, and in which the distance between the pole-pieces and the diaphragm may be varied as required for different strengths of signals by means of an adjusting screw at the back of the receiver case. The receiving set is a beautiful piece of apparatus, which includes a Pyron detector. The primary coil of the loose coupler is wound with 170 turns of No. 22 enameled copper wire, divided up into two sections, one of 10 turns and one of 150 turns. These are suitably connected up to switches, so that any combination of turns, from one to maximum, may be obtained rapidly.

The whole receiving set is installed in an oak cabinet with hard rubber top and end, upon which the switch points are mounted. It also contains a series condenser for short wave lengths, but which unit is normally short-circuited by a special switch. The secondary is also adjustable as to the inductance, and as it slides out of the primary cabinet its graduated tubular covering indicates the percentage of coupling. Photo courtesy Wireless Specialty Apparatus Co.

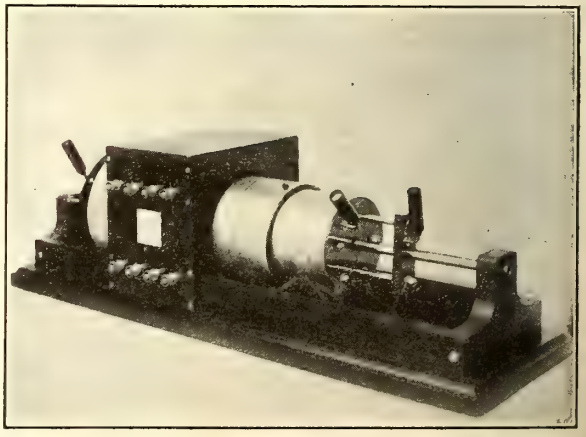
A NOVEL RADIO INDUCTIVE TUNER.

Since the introduction of the loose coupler there have been few, if any, radical changes in the design of same. The change from sliders to tapped coils was so slight as to make very little improvement, so it remained for a radio engineer of a later day to devise the apparatus shown herewith.

The old type of inductive coupler was adjusted in steps, which did not give very close tuning, and the presence of large amounts of unused wire created the bugaboo of all previous tuning apparatus, namely, "dead-end" effects, which absorb considerable energy and destroy the efficiency of the apparatus. To offset the above defects it was the general practise to use variable condensers to secure accurate tuning, and many complicated switches were devised to prevent the dead-ends. The coupler illustrated herewith does not require any taps or variable condensers, all the wire on same being in use at all times. A brief resume of the principle of this instrument will not be out of place.

The primary consists of two coils, one permanently fixed in the box, shown in the illustration, and the movable one shown at the left. These two coils are wound to have an equal amount of inductance, but in opposite directions, so that when the movable coil is slid entirely into the fixed coil the sum of their inductances will be zero, because they oppose and counteract each other.

The same principle is used in the construction of the secondary, which consists of two coils shown protruding from the end of the box to the right. These coils also have the same amount of inductance, and they also counterbalance each other when the inner coil is entirely within the outer coil. It will be apparent that when withdrawing the inner coil the exact balance of the two inductances is upset and the circuit will possess an inductance depending upon the relation of the two coils. By this simple means it is possible to adjust the active inductance in either circuit, thus doing away with all taps or sliders.



New Loose Coupler, Adjusted Without Sliders or Switches.

The secondary coils may be moved inside of the primary coils, so that by varying the inductance relation between the two sets it is possible to vary the coupling.

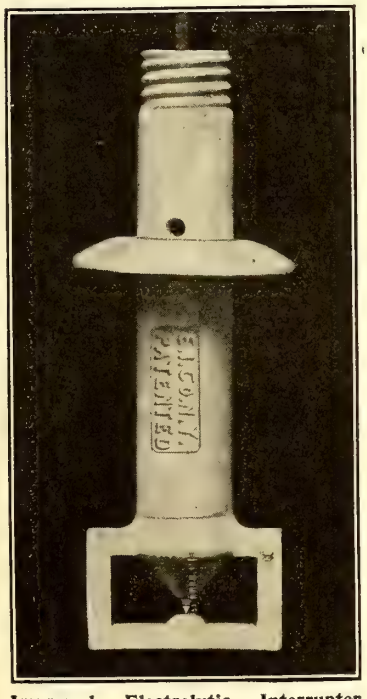
The many advantages of this apparatus will now be readily understood, for it gives

(*Continued on page* 667.)

NEW ELECTROLYTIC INTERRUPTER ELECTRODE.

An improved form of positive electrode or anode for electrolytic interrupters has been perfected by a well-known New York experimental supply house. The tube is shown in the illustration herewith. It consists primarily of a specially designed porcelain tube, which carries a thread at its upper end, intended to screw into a porcelain cover. A metal rod made of a special alloy passes down through the interior of the tube, and the point of same protrudes through a small orifice slightly larger than the rod at the base of the tube proper, as perceived. The metal wire point rests on a porcelain bridge, as illustration portrays, so that excessive current will not be drawn. Any electrolyte which may find its way into the interior of the tube by working in around the metal rod will be ejected through three small perforations in the wall of the tube just above the porcelain skirt formed on the tube about two-thirds of the way up, as perceived.

It is claimed that this marks a great advance in the design of such devices and actual laboratory tests have demonstrated that for operating wireless coils, X-ray coils and open core transformers up to one kilowatt capacity there is nothing superior to it. It will work on either A. C. or D. C. circuits at 110 or 220 volts potential and on any frequency. *The key may be held down for periods of one-half hour or more* and the interrupter will work regularly and without undue overheating. An interesting point is found in the fact that the lower end of the rod during operation wears away to a *perfect* sharp point. The rod which is consumed slowly in operation is fed down automatically by gravity. It offers a practical solution of the power transforming problem constantly confronting the wireless and electrical experimenter, especially where he desires to utilize the commercial power circuits to operate his spark coils and the like, and where he desires to utilize direct current on an open core transformer. Such interrupters are not adapted for operation with closed core transformers.



Improved Electrolytic Interrupter Electrode Recently Brought Out. The Metal Rod Cannot Drop Through the Tube, Owing to a Porcelain "Bridge" Formed as Shown.

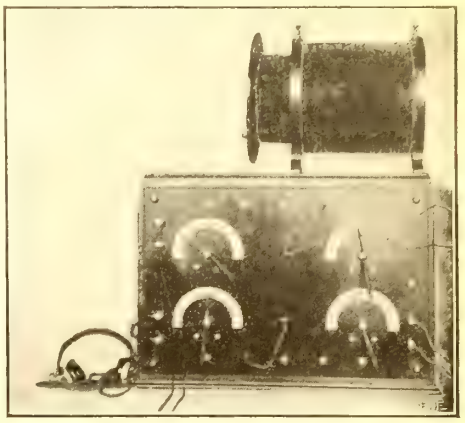
AN UNDAMPED WAVER.

A great deal of speculation has been made during the past two years by the majority of amateurs in regard to the reception of undamped waves emitted by the powerful radio stations about the globe; practically all the long distance transmission records have been accomplished only by the use of undamped waves.

The ordinary radio receiver is deaf, so to speak, to the undamped waves, so other apparatus had to be developed to receive them. Although various detector devices have been invented for this purpose, none have proved superior to the oscillating audion detector. This produces "beats" which are created by the use of properly designed inductances and condensers linked up to the audion circuit.

One of the latest receivers for undamped waves which employs the audion as a generator of "beats" is herewith illustrated. A large loose coupler is seen resting on top of the cabinet. The case contains four variable condensers which are provided with long insulating handles, the pointers of which move across the dials on the face of the instrument, as perceived in the illustration. The purpose of these handles is to prevent capacity effects due to the operator's body. The cabinet also contains the necessary inductances, the values of which can be changed by means of the jack and plug system; the jacks being located on the front of the board, as can be clearly seen in the illustration.

With the loose coupler herewith shown in connection with the variable condensers, wave lengths up to 15,000 meters can be readily obtained.



New Loose Coupler and Variable Condenser Cabinet Known as an "Undamped Waver," and Intended Especially for Receiving Continuous Wave Signals.

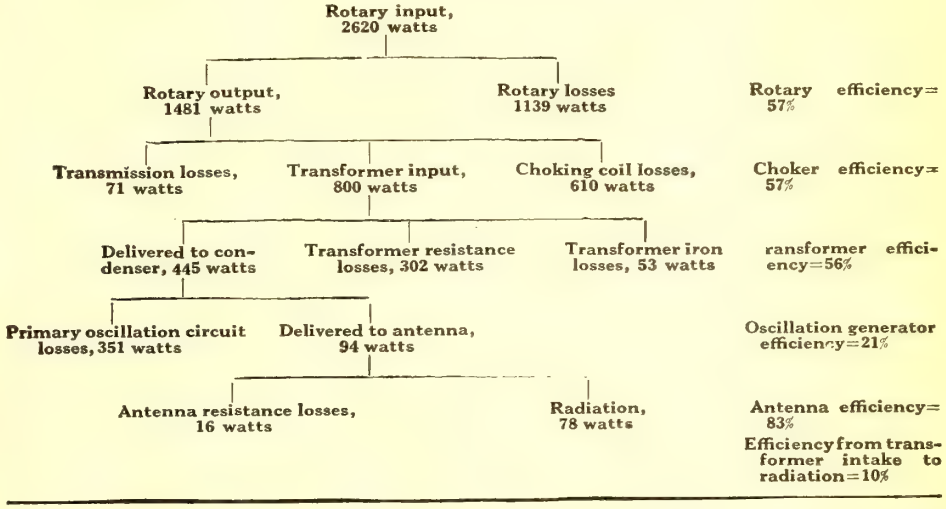
OVER-ALL EFFICIENCY IN RADIO TRANSMITTING STATIONS.

Several very vital figures are given in Dr. J. A. Fleming's new treatise, entitled "The Wireless Telegraphist's Pocket Book." We reproduce herewith an interesting chart as there given, covering the various losses in the apparatus constituting a typical transmitting set of the spark gap type. It is pointed out in the treatment of this subject to Dr. Fleming that, while these values as here reiterated are of considerable value as an over-all consideration, in respect to the over-all efficiency of modern transmitting sets, utilizing quenched spark gaps, etc., it may be a great deal higher. In comparing the power radiated, viz., 78 watts, with the power given to the step-up transformer, i. e., 800 watts, it is seen that for this particular transmitter the over-all efficiency is but 10 per cent., approximately. In the case of a well-designed spark transmitter the over-all efficiency might be raised to from 20 to 25 per cent.; that is to say, that almost one-quarter of the power given to the step-up or exciting transformer would be radiated as electric waves. Claims have been made for much higher efficiency in such apparatus, particularly for quenched spark sets when this value has been mentioned as reaching 75 per cent., but these claims have not been substantiated. This acknowledged authority points out that it is probably correct to say that the properly designed quenched spark transmitter's efficiency *may* reach a figure of 50 per cent.

He believes that it will not be far wrong to consider that in a fairly good, modern type spark transmitter, with quenched spark gap or gap equipped with an air blast, the power radiated from the antenna can be as much as 20 or 25 per cent. of that given to the exciting transformer, but it is not usual to find such high values as these. In order to realize such radio transmitter efficiency, however, great attention must be paid to the construction details of the condensers and also to those of the primary oscillation circuit and of the spark gap, as well as to the earth connection proper and to the construction of the antenna, in order to avoid undue resistance losses in these most vital parts of such a station.

EFFICIENCY CHART FOR U. C. L. RADIOTELEGRAPHIC EXPERIMENTAL PLANT, WITH 5 mm. SPARK GAP

(From tests by Dr. J. A. Fleming, at University College, London.)



The Evolution of Wireless Telegraphy

THE evolution of signaling without wires has been an interesting one. Since the earliest dawn of reason man has found it absolutely necessary to transmit important intelligence through space. Particularly in case of war between the various tribes quick intercommunication was desirable. As the fleetest runner, as well as the speediest rider, were soon found wanting, methods were naturally sought to outdistance both. In the illustrations here observed we have endeavored to show the principal modes of signaling without wires utilized in the various stages of the world's history.

Perhaps one of the first mentions is made in the Bible, when the Israelites were led out of Egypt and through the wilderness by a cloud of smoke by day and a pillar of fire by night. Possibly one of the first methods of signaling across an appreciable distance of a few miles was that involving the use of fires kindled on the hilltops or other promontories as depicted in Fig. 1. In this way it was quite possible to communicate intelligence accurately, although not very rapidly, to be sure. This scheme was first used in very ancient times.

The method of signaling shown at Fig. 2 is that employed at quite an early date, but notably by the North American Indians. This consisted in building a fire on a hill or mountain whenever possible, so that a column of smoke or a series of smoke puffs, could be sent up, and in this way communication was established between tribes. It was this method that was often utilized by the Indians when making war on the white settlers in America. The fire was made to smoulder by the use of wet sticks or leaves. The Indians were quite proficient in making fires producing a prodigious amount of smoke, which could be seen for various distances, depending, of course, upon the height of the hill upon which the fire was built, but a range of ten to fifteen miles was undoubtedly common in those days with this method of wireless communication.

Fig. 3 illustrates a little known yet very effective method of transmitting intelligence, which is attributed to certain tribes of Indians in South America; it has been described by returning explorers at different times. It may be expressed briefly as "drum beating," but the drum is no ordinary one. It consists of a hollow log, or a log made so by burning out the interior. Over the end of same is stretched the hide of an animal, which is pulled very tightly and bound by thongs. The log is then suspended, as perceived in the illustration, so as to exert the maximum resonating effect as the signaler beats the head of of the drum with a stick provided with a wooden head, or in some cases with a stick having at its extremity a ball formed from a piece of hide and loaded with a round stone. We have been credibly informed that this method is in successful use at present, messages being actually transmitted (using relay stations) over a distance of 300 miles almost every day.

Wigwagging is still in use to a great extent throughout the world, especially in the army and navy, where it has proved invaluable in many instances. This mode of signaling, which usually consists of wagging a flag or semaphore arm in different positions, representing the various letters of the alphabet, was employed at quite an early date. The illustration at Fig. 4 shows the semaphore arm as made use of for sending such signals over great distances. In the wonderful campaign of Napoleon carried out through France, Germany and Russia numerous messages were transmitted without wires in this way. In one case, it is said, that such a message was transmitted in a few hours' time from Moscow to Paris. Of course, this distance was not negotiated by one semaphore only, but the message was relayed from signal station to signal station, much in the same way as wireless messages are relayed now from ship to ship or from one ship to another and thence to shore, etc.

It is quite surprising how well sounds are carried through the earth itself, especially in rocky soil. Signals were transmitted in this way at quite an early date. At Fig. 5 the Indians are seen making use of this method of intercommunication. The scout, for instance, tapped a rock, partially buried in the ground, with another stone. At a surprisingly long distance away this sound could be heard by the Indians, whose hearing was extremely sensitive, by placing the ear to the rocky ground. Times without number the approach of men on horseback was heard in this way by the Indians, so that it was often very difficult for the United States troopers to conduct anything like regular warfare, as the savages would hear them coming several miles away and thus be able to circumnavigate them, or get to some little known hiding place.

A mode of signaling known to most of us, but one which dates back to the days of the first locomotive, is that making use of several distinct blasts of the steam whistle as portrayed in Fig. 6. Engineers to-day use this scheme for calling train crews and also for communication with other trains. One, two and three blasts of the whistle have different meanings assigned to them, etc. Locomotive whistles are often used for a signal of distress when the engine happens to be located near a large fire or when a wreck has occurred. In the latter case the whistle is usually tied down, so as to blow steadily until help comes, but at other times it is intermittently tooted.

Signaling wirelessly by means of a reflected ray of sunlight, is illustrated at Fig. 7. This method makes use of an instrument known as the Heliograph. It has been adopted by practically all army signal corps. This arrangement may be utilized without the aid of sunlight, wherever a sufficiently strong source of illumination is available, such as that produced by acetylene or electric light. Some of the army searchlights now built are provided with a shutter arrangement, similar to that fitted on the heliograph, so that long and short flashes of light may be sent out corresponding to the dots and dashes of the Morse telegraph code. Rapid signaling is thus accomplished, as it is possible to manipulate the heliograph shutter as speedily as the common telegraph key and sounder. A probable range for such devices as this may be put down as three to four miles ordinarily, but in most cases it is used for establishing communication between different signal squads or army posts at shorter distances. Signaling by this method can, of course, be carried on over a considerable range, and the more powerful the searchlight or other source of illumination utilized the greater the range.

We come now to the final method of signaling covered by this article on the evolution of wireless telegraphy, which is indicated at Fig. 8. As is well known, for this method of intercommunication there is invariably utilized a large size antenna or aerial, consisting of a number of wires supported by highly elevated masts. The illustration herewith shows roughly the appearance of the trans-Atlantic wireless telegraph station of the Marconi company located at Wellfleet, Mass. This method of signaling without wires has entirely transcended the dreams of wireless telegraphy entertained vaguely by the great scientists and engineers of even two decades ago. Wireless telegraphy in a practical sense and for commercial requirements has only been a reality since the year 1900, but to-day it has been developed to such an extent, involving the use of very high powered stations, that wireless messages may readily be propagated over such distances as 5,000 miles. This is mentioned to show what has been really accomplished, but this is freak work. Generally speaking, common ranges for moderate long distance radio telegraphy is 2,500 to 3,000 miles. There are a few stations working over such distances as 4,000 miles. Marvelous indeed has been the onward and triumphant march of science in the realm of intelligence transmission. Where and when will these wonders of science stop?

VIA "SAYVILLE" TO BERLIN.

The Telefunken station at Sayville, L. I., is one of the most powerful in the world, flashing messages nearly 4,000 miles direct to Nauen, near Berlin.

Located near the ocean and dropped in a mosquito-infested field, the great Telefunken station sprawls over 100 acres. A mile away it looks like a huge spider web, with all its slim poles reaching into the air, interlaced with slender wires. At the gate a watchman is on guard, and all along the way to the building are posted danger signs.

The little low building is rigged on every side with towering poles—antennae as they are called. Five hundred feet high they stand—almost as tall as the Washington monument. From these wires radiate the electric waves that leap across space to Germany. Great blocks of cement, big as corncribs, are set in the ground and to them are anchored the guywires.

Inside the low, one-story building, squatting at the foot of the towers, are 18 men working. Fourteen of these are censors for the United States Government, as for several months the navy has been in control of the Sayville station. Every message must be sent through them and received through them. The Telefunken employes operate the plant, but all messages have to be submitted to the Government censors.

The message is flashed across the Atlantic at the rate of 25 words a minute, but in case of necessity it can go up to 40. The messages go to a small town near Berlin called Nauen, where they are placed on a land wire and forwarded to the capital. The charge for sending a message to Germany is 53 cents a word from anywhere near New York. The 3 cents is the price of the land wire to get it to Sayville.

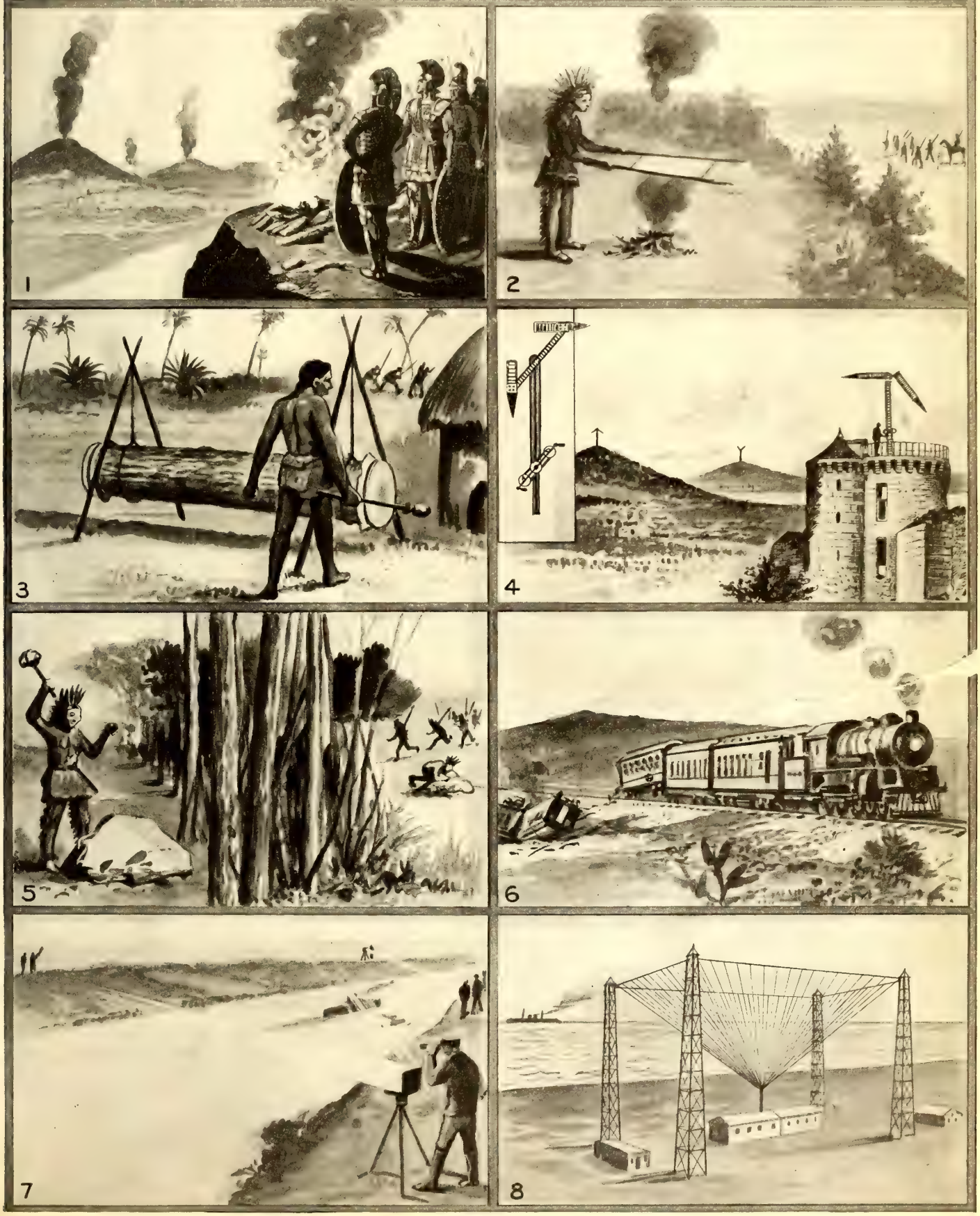
As soon as the key is touched in America the message is in Germany, the time occupied in crossing being only the fraction of a second. In fact, the message could go around the world seven times in a second.

Every message is censored before it goes out. A Government officer sits there with a blue pencil and if he suspects the message has another meaning than what is on its face he returns it to the sender; or he may paraphrase its meaning, saying the same thing in different words, which would of course upset the code message, if it contained one.

On an average 100 messages a day go out of Sayville for Berlin. Most of these

(*Continued on page* 670.)

THE EVOLUTION OF WIRELESS TELEGRAPHY

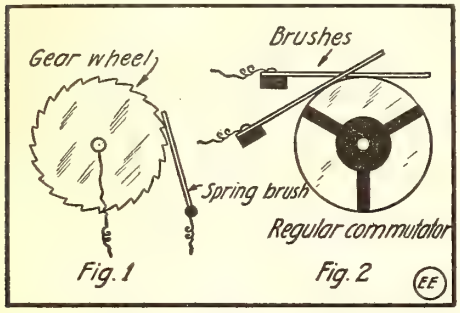


For Explanatory Text, See Preceding Page.

The Reception of Long Damped and Undamped Waves*

By Thomas Appleby

ALTHOUGH it is not generally known there are at least three stations in this section of the country (Philadelphia, Pa.) now using undamped waves for transmission. Two of these stations generate the undamped waves with the oscillating arc; while the third makes use of a high frequency generator.



Figs. 1 and 2. Two Forms of "Tikker" for Receiving Undamped Waves.

In the ordinary spark station two frequencies are used, one being the radio frequency which determines the wave length and the other the audio frequency which is produced by the rotary or quenched spark gap, and this determines the pitch of the spark as heard at the receiving station.

In an undamped wave transmitting station there should be no audio or spark frequency, as the oscillations which determine the wave length are generated by a high frequency generator of 50,000 cycles or more, or by an oscillating arc which is more or less silent in operation.

When an undamped wave is tuned in at the receiving station and an ordinary crystal detector used there should be no sound in the telephone receivers, as the radio frequency is entirely too high for the human ear. There are exceptions, however, for we can plainly hear the Tuckerton station with a crystal detector, even though they use the high frequency generator; and not only do we hear the actual sending, but we can also hear the reversed sending caused by the compensating wave, due to the manner in which the key is shunted around a few turns of the helix. However, the signals received in this manner are very faint, compared to the great strength of the signals when a tikker is used.

In order to lower the frequency of the current set up by the undamped waves; or, in other words, to produce an audible frequency, it is necessary to break up the incoming current at the receiving station.

This may be accomplished in two ways: First, by the use of a tikker, which consists in its simplest form of a rotating gear wheel with a spring held against the teeth; the pitch of the signal being determined by the speed of the tikker wheel (Fig. 1).

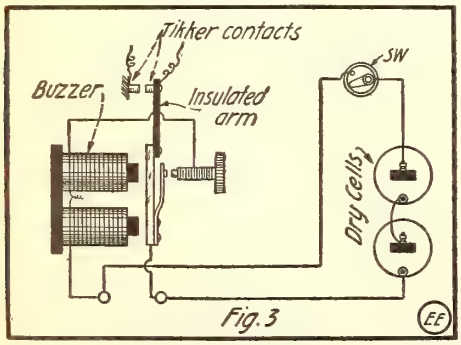


Fig. 3. "Tikker" Made Out of Ordinary Buzzer.

Another form of tikker would consist of a revolving commutator, such as is used on small motors, with two copper brushes bearing on the sections and arranged so that the circuit is constantly made and broken by the passing sections of the commutator (Fig. 2). The absence of noise in this form of tikker makes it more desirable than the first. An ordinary electric buzzer may be provided with an extra set of contacts well insulated from the buzzer itself and used as a ticker (Fig. 3). All of these break up the incoming signals into a lower or audible number of vibrations, which can be easily heard in the receivers.

It is not absolutely necessary to use a crystal detector along with the tikker, but is advisable, as the signals come in much louder.

The circuits for use with the tikker and detector are similar to the ordinary receiving circuits. The tikker may be connected in various places in the detector circuit with nearly equal results. It operates satisfactorily when in series with the detector, in series with the 'phones, across the stopping condenser, across the variable condenser, or even shunted around the secondary coil.

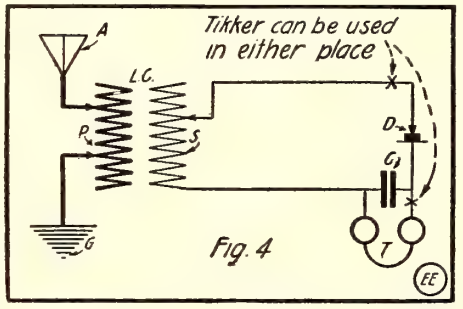


Fig. 4. Hook-Up for Poulsen "Tikker" in Receiving Circuit.

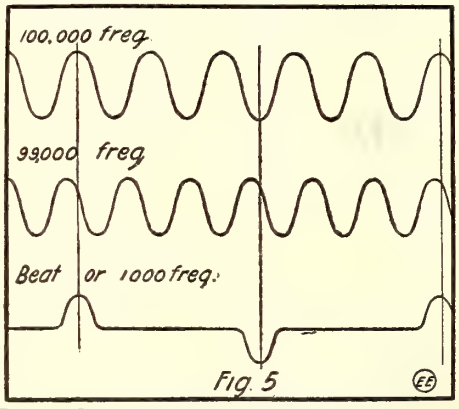


Fig. 5. Demonstrating How "Beats" Are Produced by Two Slightly Differing Oscillators in a Common Circuit.

The second method of lowering the undamped wave frequency is by means of the heterodyne effect, as discovered by Prof. R. A. Fessenden.

When two piano strings are tuned to slightly different tones, a third tone, or "beat," as it is called, will be heard. The piano tuner does not listen to the tone of the strings when tuning a piano, but listens for the "beats," which occur when the two strings are slightly out of tune. The nearer the two strings approach the same tone, the slower or lower the beats become. When the strings are considerably out of tune, the beats are very rapid and produce a high tone of their own.

In much the same manner we produce "beats" in the receiving circuit. The production of these "beats" is called the heterodyne effect. We set up oscillations in the receiving circuit which are slightly different in number than those of the incoming wave. The result is "beats," and the nearer we make our frequency to the incoming frequency the lower we will make the tone of our "beats." If the incoming frequency is 100,000 per second, and we generate 99,000 oscillations per second in our receiving circuit; the difference between the two, or 1,000, would be the frequency or tone of the beats (see Fig. 5). This would sound like the whistle of 1,000 sparks per second, as produced by the 500-cycle quenched gap.

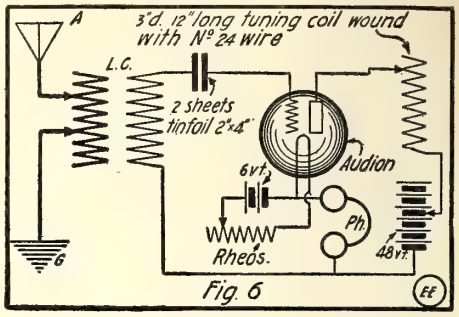


Fig. 6. Oscillating Audion Circuits.

Oscillations may be set up in the receiving circuit by means of a near-by oscillating arc, or by use of an oscillating audion as used in the ultraaudion or Armstrong circuits (see Figs. 6 and 7).

Tuckerton station (W.G.G.) makes use of a high frequency alternator and sometimes the arc for generating undamped waves. Sayville now uses the oscillating arc and Arlington also uses the oscillating arc at times to work with NBA.

Tuckerton can be heard on about 8,500 meters wave length; Sayville is on about 9,000, and Arlington on about 5,000 to 7,000 meters, considering undamped waves.

Tuckerton and Sayville work between 7 p. m. and 2 to 3 a. m.; as a rule, they work for about one hour each, Tuckerton shutting down while Sayville is working, and vice versa. Arlington transmits at times during the evening, and often during the day time.

We have received all these stations on our 300-foot, two wire aerial, in West Philadelphia, although at present we only use half of this length, or 150 feet. The loading coil in series with an ordinary loose coupler consists of a tube four inches in diameter and 12 inches long, wound with No. 24 B. & S. enameled wire. A 43 plate variable condenser is shunted around both the loading and loose coupler primary coil. In the detector circuit we use a 43 plate variable condenser across the secondary which is wound with No. 30 B. & S. silk-covered wire. We found, however, that the 43 plate condenser was unnecessary in the detector circuit and when removed the signals could be tuned in just as strong, pro-

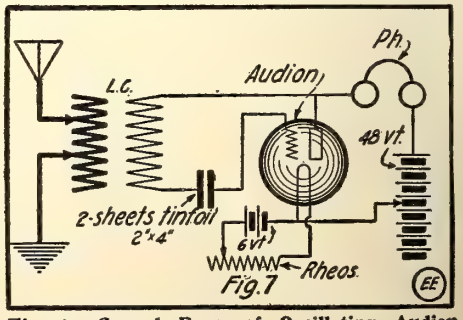


Fig. 7. Second Form of Oscillating Audion Circuit.

*Paper presented before the Wireless Association of Pennsylvania, Sept. 24, 1915.

vided tight coupling was used. Of course we do not receive efficiently with this arrangement, as the aerial is not balanced for these waves, but simply oscillates, due to

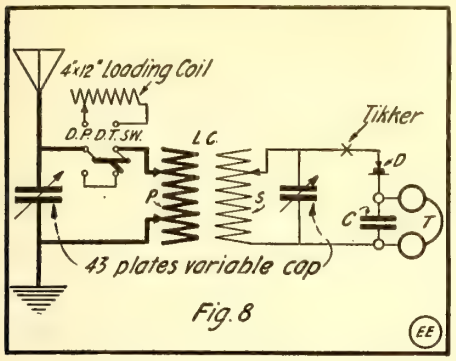


Fig. 8. Hook-Up for Reception of Undamped Waves with "Tikker," Including Loading Coil Cut-Out Switch.

forced oscillations, and sets the loading coil loose coupler primary coil and shunted condenser circuit (which is actually tuned to the desired wave length) oscillating. The detector circuit also probably oscillates, due to forced oscillations from the primary circuit (see Fig. 8).

We are now constructing the proper loading coils to load up all the circuits until we have resonance. The above arrangement is so simple and can be secured with such little additional apparatus that the average amateur will probably be inclined to give it a trial. The signals from Tuckerton, Sayville and Arlington are strong, but when resonance is secured they will be many times stronger.

We are also constructing some loading coils for use in receiving the foreign stations working on as high as 20,000 meters. Petrograd, Russia, is said to use 20,000 meter waves, as are some others. One of the new Marconi stations in New Jersey can be heard testing some evenings on 18,000 meters. They use an audio-frequency or spark system and the crystal detector is all that is necessary. A wireless authority in New York City, and another in Washington, claims that the 20,000-meter foreign stations can be easily received on a 150-foot amateur aerial, and to the experimenter who has tired of listening to the ordinary short wave stations the writer would advise that he get busy and tune in the long wave stations, especially the undamped waves.

THE GROUND LEAD AND ITS PROPER USE

By Electron.

Not one radio amateur in a hundred is

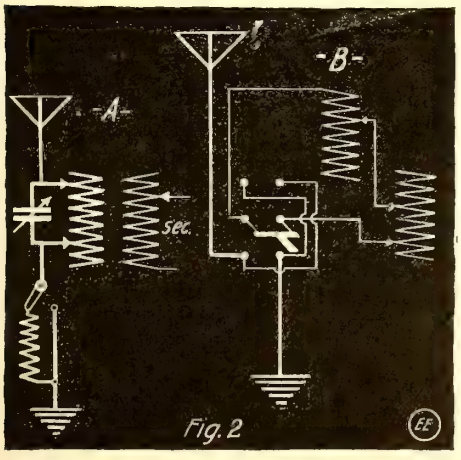


Fig. 2. Diagram of Ground Switch Change-Over for Radio Receiving Set.

aware of the possibilities of increasing his range that lie in his ground lead. It may be properly insulated and grounded, yet they overlook the benefits that may result from a little time and energy spent in making the few changes suggested in these short paragraphs.

First we will consider its length; the shorter it is the higher the amperage that is induced in the secondary circuit, and, correspondingly, the longer it is—within a certain limit—the higher the voltage in the secondary circuit.

Just why this is will be apparent by glancing at Fig. 1, which shows roughly diagrammatically the voltage and amperage characteristics in the open aerial circuit. We will consider a vertical aerial set into oscillation by an incoming wave. When this aerial is swinging in resonance with the incoming wave the induced voltage is greatest at the top and lowest at the bottom or ground connection. Hence, according to Ohm's law, the reverse is true of the current, which is lowest at the top of the aerial and maximum at the ground.

Going one step further, imagine the receiving set connected in at a point in the circuit indicated at A (Fig. 1). The cur-

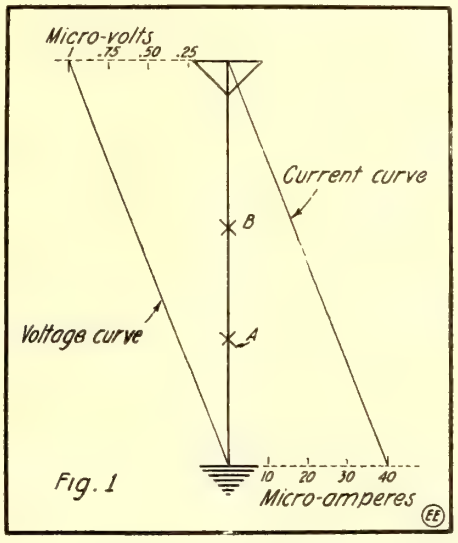


Fig. 1. Approximate Graphical Relation of Current and Voltage in Antenna.

rent here has a comparatively large ampere value and a comparatively small voltage value, therefore amperage predominates in the energy induced in the detector circuit. This condition is best for detectors acting on the thermo-electric principle, such as galena, and the signals will of course be comparatively loud.

The opposite tends to be the case when the set is connected at a point in the circuit indicated at B. Here the voltage predominates and the voltage in the detector circuit will be higher than in the previous case. These conditions are ideal for sets utilizing the audion, for instance.

The above explains the theory, and now we will consider the application of these effects to practise. It is practically impossible to change the connections as mentioned in the foregoing, but two alternatives remain.

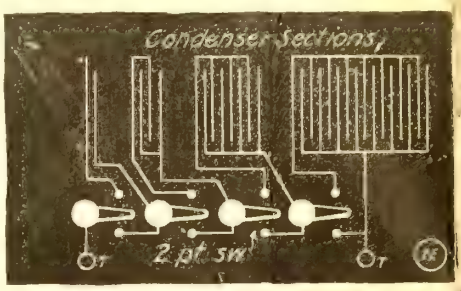
One method (A) that can be utilized to good effect is to install two ground leads, with a switch to change from one to the other. One of these leads should run as straight as possible to the ground connection and the other should possess an inductance, which may consist of about 75 turns of No. 24 C. C. magnet wire wound on a core 4 inches in diameter.

The other method (B) is to install a D. P. D. T. switch to enable one to throw the load coil from the aerial to the ground lead. It is understood if you only use mineral detectors it is unnecessary to have two leads, and if audions are used exclusively connect the load coil in the ground lead permanently.

The diagrams appended show the connections of the switches for the use of those who use both the audion and mineral detectors as receptors.

A SIMPLE VARIABLE CONDENSER SWITCH.

The following is the description of a variable condenser switch which will work on either sending or receiving types. The



Unique Switching Scheme for Adjustable Condenser.

plates are arranged as shown in the diagram and are connected to four two-point switches. The condenser plates can be of tinfoil, separated by paraffin paper for receiving or put on glass with some shellac for sending types. The whole should be placed in a box, with the switches outside in any convenient place. One more two point switch and 32 more plates can be added and the capacity is doubled.

Care should be taken not to put all the switches to the right, as it will short-circuit the other instruments.

Contributed by C. J. FITCH.

A TUBULAR VARIABLE CONDENSER.

This condenser may be constructed almost entirely of parts to be found about the average amateur workshop. The dimensions may be varied to suit conditions but the author has found the following dimensions most satisfactory: Length of outer tube, 5½ inches; diameter of outer tube, 4 inches; length of inner tube, 5½ inches; diameter of inner tube, 3¾ inches.

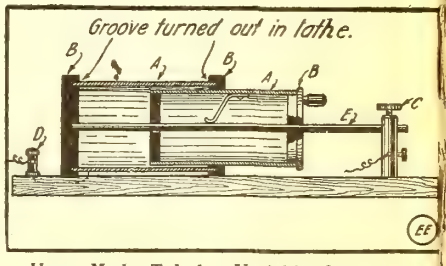
A wire soldered to the bottom makes connection with the outer tube, while connection with the inner one is made by means of a slider of phosphor bronze which presses on the brass rod as shown in the illustration.

A layer of Empire cloth, or oiled linen is secured around the inner cylinder by a thin coating of shellac, or, better, beeswax.

The uprights are composed of oak and finished with shellac. The base is best made of slate. This instrument possesses great ease of adjustment, and there is no possibility of a short circuit.

Contributed by

EARL E. NEWLIN.



Home-Made Tubular Variable Condenser.

OFFICIAL LIST OF LICENSED RADIO AMATEURS NOT TO APPEAR IN ANNUAL GOVERNMENT CALL BOOK TILL SEPTEMBER, 1916.

Amateur Radio Stations Licensed by the Bureau of Navigation During the Month of November, 1915. (Continued.)

Call signal.	Owner of station.	Location of station.	Power, kilowatts.
	SECOND DISTRICT.		
HR	Summerville, Chris.	4 Jones Pl., Yonkers, N. Y.	1
IS	Teets, Albert S.	Hillside Ave., Peckskill, N. Y.	.5
2IJ	Weller, William W.	982 Linton Ave., New York, N. Y.	.5
	THIRD DISTRICT.		
3KR	Anderson, Rich'd J.	2510 26th St., N. Wildwood, N. J.	.5
JC	Ault, Arthur K.	1152 Columbia Ave., Baltimore, Md.	.5
KS	Bernhard, William	2119 Fairmount Ave., Baltimore, Md.	.5
KH	Don Bosco Institute	507 S. 9th St., Philadelphia, Pa.	.5
KT	Elder, Lucius W.	407 Wayne Ave., Wayne, Pa.	.5
LX	Geiglein, Henry S.	2583 W. Fayette St., Baltimore, Md.	1
MK	Griscom, Samuel B.	32 Walnut St., Salem, N. J.	.5
KV	McDowell, A. P., Jr.	41 Carpenter St., Philadelphia, Pa.	.5
KW	Mehring, Charles, Jr.	414 Reily St., Harrisburg, Pa.	.5
LV	Podemski, Paul	1602 Beulah St., Philadelphia, Pa.	.5
LE	Samaha, Edward F.	2 Oriental St., Atlantic City, N. J.	.5
	FOURTH DISTRICT.		
CX	Breck, Charles	50 Logan Ave., Atlanta, Ga.	.5
	FIFTH DISTRICT.		
DK	Coleman, Jess B.	811 17th St., Temple, Texas	.5
OL	Mount, Robt. H.	Pineville, La.	1
	SIXTH DISTRICT—None.		
	SEVENTH DISTRICT.		
KH	Adams, Alfred L.	Silverton, Ore.	.5
LI	Cavender, Howard M.	511 Terry Ave., Seattle, Wash.	.5
RC	Cook, Richard H.	324 N. I St., Tacoma, Wash.	1
FK	Gale, Charles W.	111 E. 48th St., Portland, Ore.	.5
PV	Kraft, Vincent L.	4745 11th Ave., N.E., Seattle, Wash.	1
IN	Nelson, Mikko	Deep River, Wash.	.5
LD	Noel, Lionel S.	Snohomish, Wash.	.5
FO	O'Dell, Charles M.	7856 Stroud Ave., Seattle, Wash.	.5
PF	Rasmussen, Viggo P.	1215 Hudsn St., Pt Townsend, Wash.	.5
OW	Willis, Cecil D.	1316 Columbia St., Seattle, Wash.	.5
	EIGHTH DISTRICT.		
8HL	Blake, F. B.	Cattaraugus, N. Y.	.5
8UJ	Boardman, Thos. H.	813 Lincoln Ave., Port Huron, Mich.	.5
8CN	Burton, James F.	345 Whitman Ave., Bloomsburg, Pa.	1
8IU	Eaton, Floyd W.	1901 Milton Ave., Solvay, N. Y.	.5
8PE	Fisher, George C.	546 Utah St., Toledo, Ohio.	.5
8MZ	Goodrich, Harry	443 North Ave., Girard, Ohio.	1
8VU	Kane, Wm. C., Jr.	221 Reservoir Ave., Rochester, N.Y.	.5
8AMB	Koch, Frank	3402 Highland Ave., Cincinnati, O.	.5
8GO	Kohnitz, Harvey F.	104 Maple Ave., Plymouth, Mich.	.5
8JG	Lord, Harry R.	531 Beach Ave., Cambridge Spgs, Pa.	1
8OW	Mitchell, Edward H.	539 Main St., Findlay, Ohio.	.5
8LO	Nabring, Franklin	52 Foster Ave., Norwalk, Ohio.	.5
8TI	Newbold, James L.	111 Orchard St., Solvay, N. Y.	.5
8JH	Nichols, Raymond B.	Cattaraugus, N. Y.	.5
8MK	Vonderhaar, Elliott	123 Valencia Ave., Cincinnati, Ohio.	.5
8VQ	Ziska, Alfred	7704 Brinsmade Ave., Cleveland, O.	.5
	NINTH DISTRICT.		
9WL	Bierbach, Werner	655 S. Delaware Ave., Milwaukee.	1
9NO	Coquilette, Glenn E.	117 Hutchins St., Woodstock, Ill.	.5
9WN	Ferdinand, Harry P.	1315 School St., Rockford, Ill.	.5
9KB	Forbes, Henry C.	3532 11th Ave., S. Minneapolis.	.5
9WO	Garrett, Sherman	504 W. Wash. St., Champaign, Ill.	1
9WI	Kelley, Eugene V.	1311 W. Maple Ave., Independence, Mo.	.5
9IP	Nell, Edward, Jr.	2023 Talbott St., Indianapolis, Ind.	.5
9IG	Reeder, Vern K.	2705 Highland Pl., Indianapolis, Ind.	1
9SV	Ruzek, Oscar E.	Flat Rock, Mich.	.5
9WM	Smith, Stanley	1552 E. 61st St., Chicago, Ill.	.5
9IM	Smith, Wallace W.	13 Eastover Park, Louisville, Ky.	1
9WJ	Struver, Harold W.	1218 Lafayette St., Ft. Wayne, Ind.	.5
9CB	Taferl Electric Co.	236 W. Jefferson St., Louisville, Ky.	1
9JV	Teetor, Macy O.	Hagerstown, Ind.	.5
9WK	Thomas, Carroll W.	746 16th St., Milwaukee, Wis.	.5
9FY	Zimmerman, Clinton J.	117 S. Washington St., Buquoin, Ill.	1

NOTE.—Hereafter, all power will be stated in kilowatts instead of watts. All stations using power up to and including 500 watts will be rated as .5 kilowatt tions; all stations using power above 500 watts up to and including 1,000 watts will be rated as 1 kilowatt stations. This will be carried out in the List of dio Stations of the United States, 1916 edition.

Amateur Radio Stations Licensed by the Bureau of Navigation During the Month of December, 1915.

Call signal	Owner of station.	Location of station.	Power kilowatts.
	FIRST DISTRICT.		
A	Allen, George H.	16 Bacon St., Waltham, Mass.	.5
W	Bailey, Philip A.	64 Washington St., Middletown, Conn.	1
A	Barker, Gulian D.	19 Channing St., Newport, R. I.	.5
AZ	Bates, Roger S.	184 Pine St., Wollaston, Mass.	1
BA	Beattie, Robert	21 County Road, Everett, Mass.	.5
BK	Bent, Arthur S.	84 Commonwealth Ave., Boston, Mass.	.5
BS	Bliss, Donald H.	12 Dean St., Attleboro, Mass.	.5
B	Brackett, Walter F.	24 Maple St., Stoneham, Mass.	.5
BJ	Brockington, Harry G.	69 Lincoln St., Laconia, N. H.	.5
H	Burke, Henry M.	59 Chatham Road, Everett, Mass.	.5
BL	Campbell, John A.	9 Fairlee St., Somerville, Mass.	.5
BY	Carr, Albert E.	8 Decatur St., Worcester, Mass.	.5
BT	Coolikoff, Jacob	112 Broadway, Chelsea, Mass.	.5
BC	Clark, Charles V.	25 Pierce Ave., Beverly, Mass.	.5
D	Crie, Oscar H	Castine, Maine	.5
BQ	Crosby, Leslie W.	12 Elmwood Road Swampscott, Mass.	.5
AU	Donahue, Frank J.	32 Whittier St., Lynn, Mass.	.5
BO	Donnelly, George F.	South Meriden, Conn.	.5
	Eddy, James C.	489 Common St., Belmont, Mass.	.5
BD	Engel, Richard B.	35 5th St., Medford, Mass.	.5
BF	Fitch, Clinton	22 Cottage Pl., Waterbury, Conn.	1
	Frank, Louis G.	21 Summit Ave., Brookline, Mass.	.5
H	Goularte, Manuel L.	R. F. D., Fairhaven, Mass.	.5
AS	Gould, Clyde S.	123 Hamilton Ave., Lynn, Mass.	.5
BG	Graves, William S.	Sunapee, N. H.	.5
	Guilmette, Edward J.	343 Mason St., Woonsocket, R. I.	.5
	Hallett, Charles E.	28 Norcross Ter., Lynn, Mass.	.5
BU	Hertz, Wm. F. C., Jr.	57 S. Water St., New Haven, Conn.	.5
	Keyes, Perley P.	71 School St., Sanford, Maine	.5
	Lynch, Sherman W.	26 Abbott St., Beverly, Mass.	.5
	McHenry, Albert T.	64 Cutter St., Melrose, Mass.	.5
BV	McKinney, Roscoe H.	Thomaston, Maine	.5
A	Mercer, W. Roy	34 Webster St., Allston, Mass.	.5
BH	Mooradian, Arom P.	144 Lawton Ave., Lynn, Mass.	.5
AM	Murray, James J.	28 Wensley St. Boston Mass.	.5
	Nickerson, Edgar W.	16 Atlantic Ave., Beverly, Mass.	.5
BP	Pope, Donald R.	2 Winthrop, Danvers, Mass.	.5
K	Prescott, Earle M.	6 Lincoln St., Stoneham, Mass.	.5
	Reid, Ralph A.	8 Cedar St. Wakefield, Mass.	.5
U	Seibert, Leroy G.	Berlin, Conn.	.5
Q	Sherman, Joseph E.	349 Tremont St., Boston, Mass.	.5
	Simmons, Minot A.	124 Beech St., Roslindale, Mass.	.5
AX	Snow, David F.	15 Lincoln St., Arlington, Mass.	.5
BR	Stevens, Charles L.	19 Lincoln St., Stoneham, Mass.	.5
AP	Stevens, Louis W.	394 Riverway, Boston, Mass.	.5
BE	Taylor, Frederic W.	30 S. Main St., Attleboro Mass.	.5
G	Turner, Edwin E.	72 Wyman St., Jamaica Plain, Mass.	.5
P	Wallace, Wm. H.	30 Hastings St., Cambridge, Mass.	.5
PI	Wells, Herbert A.	32 Nelson St., Dorchester, Mass.	.5
	Wetherell, Fred L.	37 Peck St., Attleboro, Mass.	.5
Z	White, I. Davis	Peterboro, N. H.	.5
	SECOND DISTRICT.		
	Adams, Earl F.	1048 Julia St., Elizabeth, N. J.	.5
	Atwater, Charles K.	40 Oakwood Av., Up. Montclair, N. J.	.5
HS	Bergner, James A.	206 High St., Brooklyn, N. Y.	.5
E	Booth, Sherman F.	30 Center St., New York, N. Y.	.5
AR	Byrne, William	85 N. 120th St., Rockaway Pk., N. Y.	.5
	Carruthers, David	135 Waverly Pl., New York, N. Y.	.5
	Foster, Dudley E.	423 4th Ave. Neward, N. H.	.5
I	Fricke, Wm. B.	156 N. Arlington Av., E. Orange, N. J.	.5
C	Garity, Wm. E.	324 Reid Ave., Brooklyn, N. Y.	.5
R	Haight Russell P.	18 Spruce St., Bloomfield, N. J.	1
	Katz, Frederick	1464 Seabury Pl., New York, N. Y.	.5
	Lockwood, Nelson W.	237 Prospect St., E. Orange, N. J.	.5
P	McClintock, Ralph W.	125 High St., Nutley, N. J.	.5
	SECOND DISTRICT.		
2GO	Mulligan, Harry G.	62 Chestnut St., Albany, N. Y	.5
2UV	Oliver, Geo. E.	511 Ave. A., Bayonne, N. J.	.5
2JP	Pruden, Harold M.	142 N. 15th St., E. Orange, N. J.	.5
2JI	Ruhlmann, Ernest R.	97 W. 34th St., Bayonne, N. J.	.5
2KQ	Schaefer, Regnell C.	185 N. 16th St., East Orange, N. J.	.5
2JB	Smith, Clarence B., Jr.	1017 South Ave., Westfield, N. J.	1
2UV	Squire, Milford	122 Guion Ave., Richmond Hill, N. Y.	.5
2AQ	Wak, Henry	82 17th Ave., Newark, N. J.	.5
	THIRD DISTRICT.		
3OJ	Barron, John H., Jr.	3022 Abell Ave., Baltimore Md.	.5
3WH	Berkeley, Kenneth H.	3422 Center St., N. W., Wash., D. C.	.5
3AAJ	Blair, C. Drewry	1804 Hanover Ave., Richmond, Va.	.5
3AEM	Booz, Walter N.	237 W. Pine St., Wildwood, N. J.	.5
3ADA	Bott, James M.	1011 W. Cumberland St., Phila., Pa.	.5
3OH	Bryan, John D.	1927 S. Salford St., Phila., Pa.	.5
3AAG	Carroll, Louis, Jr.	26 S. New Jersey Av., Atlantic C., N. J.	.5
3WI	Darnell, Albert H., Jr.	129 S. Penna. Ave., Atlantic City, N. J.	.5
3ADL	Ellis, Edmund K.	Bethesda, Md.	.5
3AKE	Enslin, Louis R.	1731 N. 21st., Phila., Pa.	.5
3MT	Gardner, Wm. L.	1612 N. 4th St., Harrisburg, Pa.	.5
3RO	Gravely, Willis T.	854 Main St., Danville, Va.	1
3MZ	Jodry, Ray S.	Quincy, Pa.	1
3WW	Keller, Paul A.	13th St., and Lehigh Ave., Phila., Pa.	.5
3SQ	Kupp, Clarence L.	451 Lincoln Ave., Pottstown, Pa.	1
3UB	Lamb, Roland H.	1131 Gorsuch Ave., Baltimore, Md.	.5
3OA	Lentz, Arthur F.	18 Fairview St., West Catasasqua, Pa.	.5
3UE	Lindauer, Herman E.	3409 Piedmont Ave., Baltimore, Md.	.5
3QE	Long, Perry H.	133 Runnymede Ave., Wayne, Pa.	.5
3NR	Maul, Gilbert E.	Chatham, N. J.	.5
3AAP	Roehm, John A.	666 Union St., Lancaster, Pa.	.5
3VO	Schall, John R.	1318 Turner St., Allentown, Pa.	.5
3QA	Stevens, Lewis D.	5224 Delancey St., Phila., Pa.	.5
3AAC	Swartz, French V.	26 S. N. J. Ave., Atlantic City, N. J.	.5
3AAY	Wagner, Laurence E.	6077 Allman St., Philadelphia, Pa.	.5
3OR	Walker, Donald R.	552 Kohn St., Norristown, Pa.	.5
3OQ	Welke, Paul L.	39 S. Stricker St., Baltimore, Md.	.5
3WG	Worley, Robert A.	940 Carteret Ave., Trenton, N. J.	.5
	FOURTH DISTRICT.		
4CZ	Ashley, Robert C.	738 4th Ave., N., St. Petersburg, Fla.	1
4CY	Cooper, Frank P.	717 S. Edison St., Tampa, Fla.	.5
4DD	Emory University	Oxford, Georgia.	1
4DA	Fogarty, John J.	707 Azeele St., Tampa, Fla.	1
4DB	Lesley, John L.	114 Hyde Park Pl., Tampa, Fla.	.5
4DE	Moore, Thomas H., Jr.	321 N. Spring St., Pensacola, Fla.	.5
4DC	Peer, Emmitt E.	419 Duval St., Jacksonville, Fla.	1
	FIFTH DISTRICT.		
5DN	Collins, Wm. A.	328 Arabella St., New Orleans, La.	.5
5BO	Floyd, Preston M., Jr.	213 E. Blvd., Baton Rouge, La.	.5
5DP	Geren, A. Blanchard	1815 W. Gary St., Shreveport, La.	.5
5DM	Reid, Kenneth M.	1001 Columbus Ave., Muskogee, Okla.	.5
5DO	Wolover, Wm. H.	624 Eastside Blvd., Muskogee, Okla.	.5
	SIXTH DISTRICT.		
6GA	Andrews, Gaylerd.	4734 Shattuck Ave., Oakland, Cal.	.5
6DV	Bales, Edward M.	1006 N. Main St., Napa, Cal.	.5
6CB	Bascom, Carleton V.	1020 E. 27th St., Los Angeles, Cal.	.5
6EW	Bertin, Edwin	917 Ave. A, Coronado, Cal.	.5
6BE	Birkeland, Andrew	22 Fairmount St., San Francisco, Cal.	.5
6BD	Carter, E. Stewart	1639 Formosa Ave., Los Angeles, Cal.	.5
6JP	Clark, John H.	316 E. 55th St., Los Angeles, Cal.	.5
6CF	Curtis, Burbank	519 E. 9th St., Long Beach, Cal.	.5
6DE	Davidson, James D.	462 W. Grand Ave., Pomona, Cal.	.5
6RD	Deardorff, Ralph W.	202 Cypress Ave., Santa Ana, Cal.	1
6DG	Duffey, Guy H.	1622 W. 24th St., Los Angeles, Cal.	.5

(To be continued.)

THE CONSTRUCTOR



The Use and Construction of a Decremeter

By Milton B. Sleeper

WHILE most experimenters are familiar with the measurements commonly made in radio work, not many understand the measurement of "decrement." Since the sharpness of the radiated wave depends upon the decrement (or damping), this value must be measured if the tuning characteristics of a transmitter are to be predetermined or made known. To reduce the interference as far as possible, the law requires that the logarithmic decrement shall not exceed 0.2. Several kinds of decremeters* have been developed, but the one described here is the simplest. This type was first used by the Marconi Co.; the formula on which its operation depends is due to V. Bjerknes. The construction of the instrument will first be taken up; then its use.

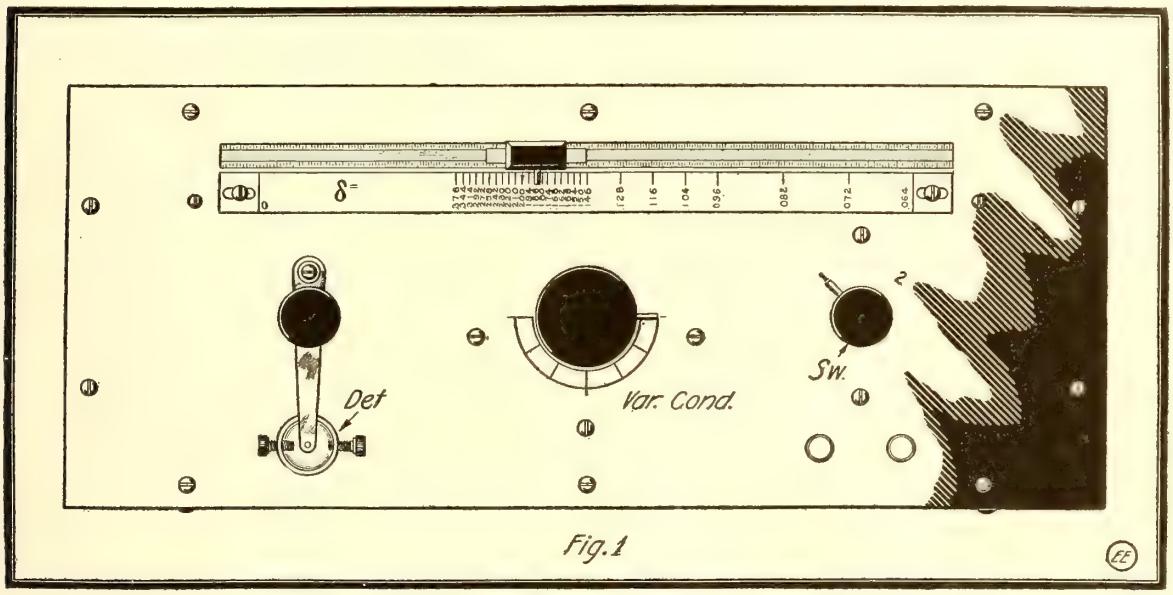


Fig. 1. Front View of Finished Decremeter.

Construction of the Decremeter.

Fig. 1 shows the front of the instrument, while Fig. 2 gives the connections. At the left of the front view is the detector. Any mineral is suitable if it holds its adjustment well. The handle in the center is for the variable condenser. At the right is the switch, represented in the diagram of connections by the numbers 1, 2, 3, 4, 5, 6. Below the switch are binding posts for connecting any suitable 'phones. Across the top is arranged a slider which projects through the slot in the hard-rubber front. The damping decrement can be read directly from the scale. If it is desired the decremeter can be calibrated at the Bureau of Standards, Washington, D. C., but if the decremeter is carefully constructed it will be accurate enough for all purposes. Although it is far better to keep all the parts inclosed, this instrument will work as well if the essential parts are made according to the drawings, but mounted on a plain base.

The Variable Condenser.

The condenser is of the rotary type and of about .0005 mfds. capacity. It is much better in most cases to buy a condenser than to make one. However, the home-made one described here will be satisfactory if the instructions are closely followed. A list of parts is given to help the builder in getting the material ready. From perfectly flat No. 25 gauge aluminum sheet, cut out 10 pieces 2½x1½ inches. These are for the rotary plates. On two mark out the shape of the plates as shown by 17 in Fig. 3. Clamp the stack of plates between two blocks of wood the marked pieces on the outside. Using these as a guide, cut along the lines with a fine hand jig-saw, well lubricated with kerosene. Drill the holes for the shaft, too, while the plates are still clamped. From rectangles 3x1½ inches cut out the nine thin stationary plates and the two thick ones, acccording to the drawings. Drill the holes around the edges, but

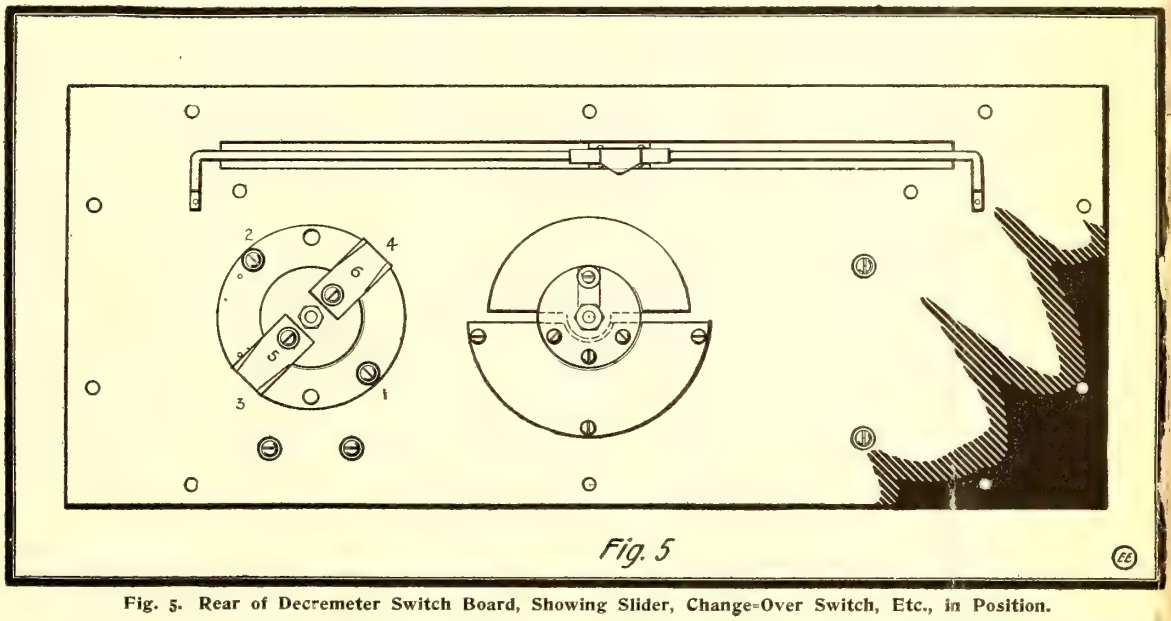


Fig. 5. Rear of Decremeter Switch Board, Showing Slider, Change-Over Switch, Etc., in Position.

*This decremeter was actually built and checked against a standard instrument. With a little care a faithful duplicate can be constructed. —EDITOR.

do not drill the holes for the bearings in the thick plates. If there are any burrs on the plates, rub them off with emery cloth. Washers can usually be purchased. They must be between 0.063 and 0.062 inches in thickness. Test each one with a micrometer. In drilling the bearings, 14 and 15, clamp them to the thick plates and drill the holes in all of them at the same time; otherwise the bearings will not be in alignment, and the plates will touch. Now tap the holes for the screws, 7, which hold the bearings to the thick plates.

When the stationary plates are finished to the front of the case. The threaded washers, 9, are to hold the rotary plates in position on the shaft. To make sure that both sets of plates have been tightened up the same amount, try the edges of the assembled rotary plates against the assembled stationary ones. Finally, slip the rotary plates between the stationary ones, put the bearings on the shaft, and screw them down in place. When it is time to put the condenser on the hard-rubber front bend the spring, 1, to a bow shape. It belongs on the shaft between the front and the handle. This spring, pressing against the handle, will hold the plates in any position. The nuts, 6, hold the plates from being pulled out of alignment by the spring. In the side view of the assembled instrument, Fig. 4, the complete condenser is clearly shown. The connecting wires have been omitted to make the drawing clearer. Fig. 5 shows the condenser in position on the back of the hard-rubber front. The connection wires are left out in this drawing also.

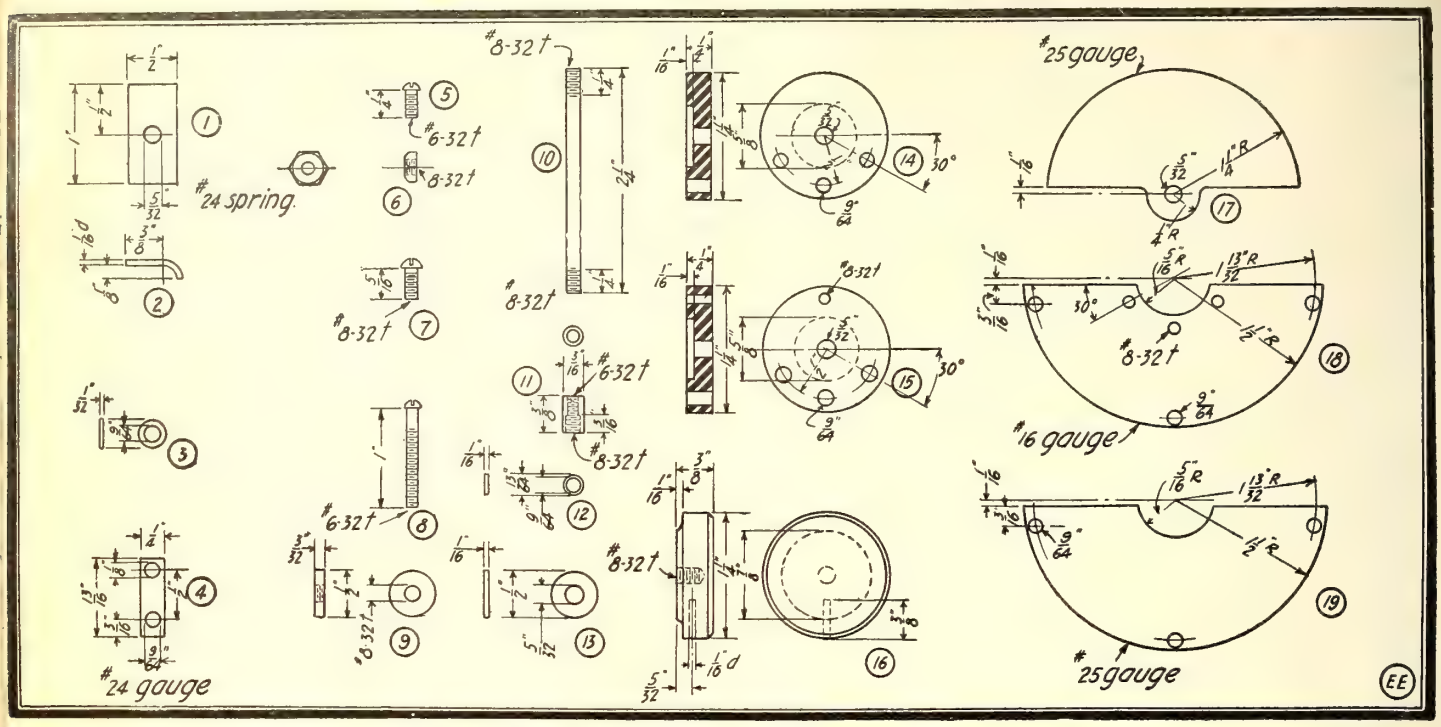


Fig. 3. Details of Decremeter Variable Condenser Parts.

assemble them on the screws, 8. The ends of the pieces 11, which have the smaller holes, go on the screws 8 to keep the plates right; the ends with the larger holes are for the screws 7, which hold the condenser

The Inductance Coils.

The inductance coils and contact slider are depicted in detail in Fig. 6. Wind the long coil, 32, with No. 22 double cotton covered copper wire. By soldering a piece of copper foil to the bared wire take taps at the 26th and 52d turns. Wind the smaller coil with 26 turns of No. 22 double cotton covered copper wire. The completed coils are shown in Fig. 4 as they appear when held in place by the straps 40.

Be very careful in laying out the scale 45. Divide the 8-inch space into 100 equal parts.

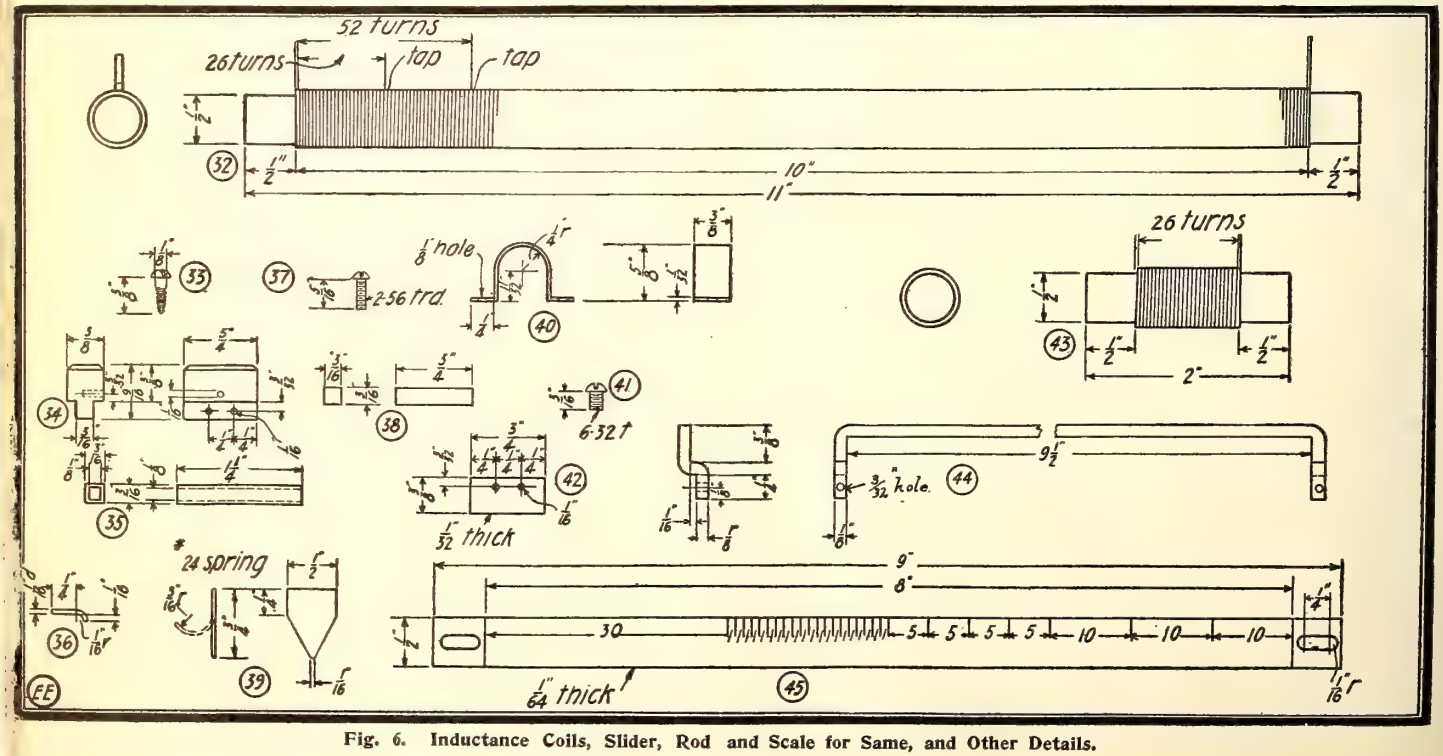


Fig. 6. Inductance Coils, Slider, Rod and Scale for Same, and Other Details.

Then make the divisions for the *decrement readings* as given in the table below:

Number of Graduation Marks on the Scale with Decrement Readings.

Scale.	Decrement.	Scale.	Decrement.	Scale.	Decrement.
30	0.378	40	*0.200	49	0.150
31	0.344	41	0.194	50	0.146
32	0.314	42	0.186	55	0.128
33	0.292	43	0.180	60	0.116
34	0.272	44	0.174	65	0.104
35	0.258	45	0.168	70	0.096
36	0.242	46	0.162	80	0.082
37	0.230	47	0.158	90	0.072
38	0.220	48	0.154	100	0.064
39	0.210				

*Legal limit.

When the scale is in position on the hard-rubber front move it until the pointer is on the zero mark, when the slider contact is on the 26th turn of the larger inductance. This must be done carefully if the meter is to be accurate.

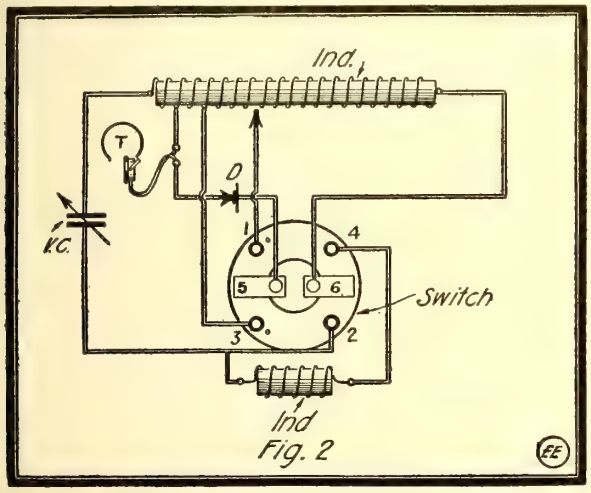


Fig. 2. Wiring Diagram for Parts of Decremeter.

This makes a place for the narrow part of the slider handle, 34, to fit in. Solder the contact, 39, to the bottom of the tube. Now fasten the handle to the slider by means of escutcheon pins or small rivets, put through the holes in the handle and the side pieces 42. Fit the pointer, 36, tightly in the hole of the handle. Be sure to put the completed slider on the rod, 44, before bending the rod in the shape indicated by the drawing. Make sure, also, that the contact is on the right side of the rod. These parts finished, we may start constructing the change-over switch.

[In the second part of this paper on the construction of a decremeter Mr. Sleeper explains how to use same for measuring wave length, decrement, etc. Don't miss it!—Ed.]

WAVE LENGTH AND DAMPING.

It is a little known fact that the Government pays little or no attention to a highly damped wave under 200 meters, whereas it reprimands and punishes amateurs who use a wave length in excess of 200 meters. Select the lesser evil to avoid fines. However, for maximum range the decrement should be kept down.

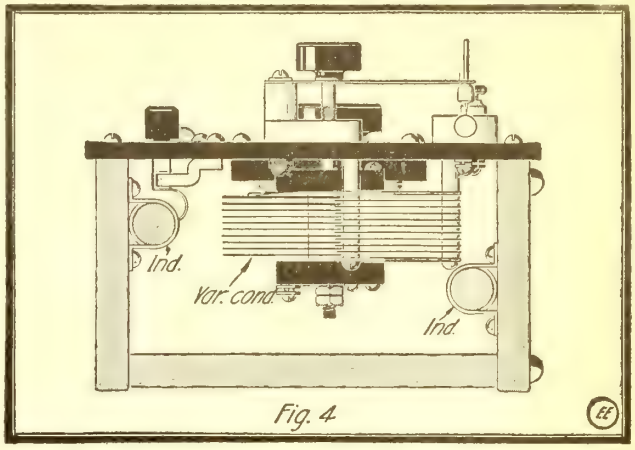


Fig. 4. End View of Decremeter with Cabinet Board Removed.

LIST OF PARTS.

Drawing Number	Name of Part	Size	Pieces	Material
1	Spring to go on shaft under handle	1″x ½″x 24 gauge	1	Spring brass
2	Pointer for handle	9/16″x 1/16″ diam.	1	Brass
3	Washers to hold connection wires	1/32″x 5/16″ diam. 9/64 hole	2	Brass
4	Connection piece for bearing	13/16″x ¼″x 24 gauge	1	Brass
5	Screw for making connection to No. 4	¼″, 6-32 thread	1	Brass
6	Nuts to adjust plates	8-32 thread	2	Brass
7	Screws to fasten bearings to outside plates	5/16″, 8-32 thread	6	Brass
7	Screws to fasten No. 11 to front of case	5/16″, 8-32 thread	3	Brass
8	Screws to hold stationary plates together; goes in No. 11	1″, 6-32 thread	3	Brass
9	Washers to hold rotary plates	3/32″x ½″ diam. 8-32 T	2	Brass
10	Shaft for rotary plates	2¼″, 8-32 thread	1	Brass
11	Pieces to hold stationary plates to front	⅜″x 3/16″ diam. 8-32 and 6-32 thread	3	Brass
12	Separators for fixed plates	1/16″x13/64″ diam. 9/64″hole	30	Brass
13	Separators for rotary plates	1/16″x½″ diam. 5/32″ hole	9	Brass
14	Bearing nearer front of case	¼″x 1¼″ diam.	1	Hard rubber
15	Bearing at back	¼″x 1¼″ diam.	1	Hard rubber
16	Handle	⅜″x 1¼″ diam.	1	Hard rubber
17	Rotary plates	25 gauge, 2½″ diam.	10	Aluminum
18	Outside stationary plates; fasten bearings to them	16 gauge, 3″ diam.	2	Aluminum
19	Inside stationary plates	25 gauge, 3″ diam.	9	Aluminum
20	Nuts to screw on either side of No. 30	8-32 thread	2	Brass
21	Pointer for handle	⅝″x 1/16″ diam.	1	Brass
22	Switch contacts	1″x ½″, 24 gauge	2	Spring brass
23	Spring to go under handle	1″x½″, 24 gauge	1	Spring brass
24	Washers for connections	1/32″x5/16″ diam. 5-32″ hole	12	Brass
25	Pins to stop contacts	⅜″x 1/16″ diam.	2	Brass
26	Screws to hold No. 31 to front of case	⅜″, 8-32 thread	2	Brass, round head
27	Screws to hold connections	¼″, 8-32 thread	6	Brass, round head
28	Shaft	1″, 8-32 thread	1	Brass
29	Handle	⅜″x ¾″ diam.	1	Hard rubber
30	Movable contact holder	⅜″x 1¼″ diam.	1	Hard rubber
31	Stationary contact holder	¼″x 2 5/16″ diam.	1	Hard rubber
32	Core for large coil	11″x ½″ diam.	1	Well-seasoned wood
33	Screws to fasten coil holders to case	⅜″x⅛″ diam.	8	Brass
34	Handle of slider	¾″x 9/16″x ⅜″	1	Hard rubber
35	Tube for slider	1¼″x⅛″ sq. i.d. 3/16″ sq. o.d.	1	Brass
36	Pointer for slider handle	⅜″x 1/16″ diam.	1	Brass
37	Screws to fasten slider rod to front of case	5/16″, 2-56 thread	2	Brass, round head
38	Support for slider handle	¾″x 3/16″x 3/16″	1	Brass
39	Contact for slider	¾″x ½″, 24 gauge	1	Spring brass
40	Coil holders	2″x ⅜″x 1/32″	4	Brass
41	Screws to hold scale to front of case	3/16″, 6-32 thread	2	Brass, round head
42	Pieces to hold slider handle	¾″x ⅜″x 1/32″	2	Brass
43	Core for small coil	2″x ½″ diam.	1	Seasoned wood
44	Slider rod	11″x⅛″x⅛″	1	Brass
45	Scale	9″x ½″x 1/64″	1	Celluloid
46	Front of case	12¾″x 5½″x 3/16″	1	Hard rubber
47	Back of case	11¾″x 4½″x ⅜x ⅜″	1	Mahogany
48	Top and bottom of case	12⅝″x 2 11/16″x⅜″	2	Mahogany
49	Ends of case	2 10/16″x 4½″x⅜″	2	Mahogany

To assemble the slider, first solder the piece 38 on the middle of the tube 35. To opposite sides of 38 solder the pieces 42.

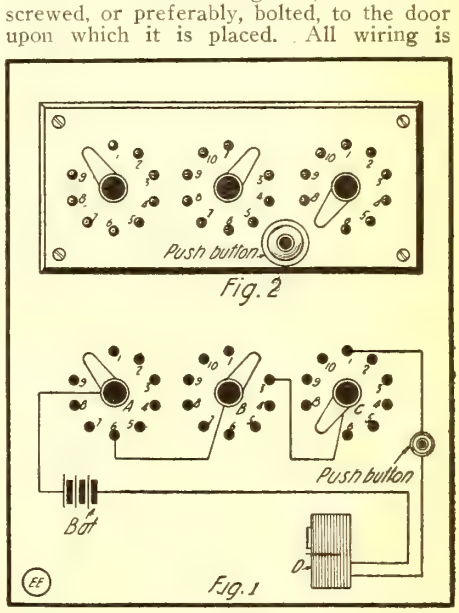
AN ELECTRIC COMBINATION LOCK.

A secret electrical lock is frequently desired on cupboards, little closets and shop doors to keep out undesirable parties. The common method of opening these locks is to use secret contacts, such as two nails, the circuit being closed by a coin or piece of metal.

The lock herewith described has many of the advantages of the above, but is in the form of a combination and can be opened by no one save those who know the prearranged setting of the lock.

The materials needed are 3 switch levers, 30 contact points, 1 push button, 2 or 3 good dry cells and an electric door opener. The circuits and wiring diagram are shown in Fig. 1. A, B and C are the switch levers. Ten contacts are used per switch and arranged on a 1-inch board, 8½x4½ inches. After the levers and contacts are arranged the combination is to be decided upon and hooked up accordingly. In the illustration the combination is 6-3-1. It will be seen that unless switch lever A is on contact 6, switch lever B on contact 3 and switch lever C on contact 1, it will be impossible, upon pushing the button, to open the door upon which the electric lock D is fastened. A great variety of combinations can be had, it being possible to arrange 1,000 different settings with the scheme illustrated.

The appearance of the finished device will be as shown in Fig. 2. It should be screwed, or preferably, bolted, to the door upon which it is placed. All wiring is taken to the inside of the door to prevent anyone meddling with the circuits.



Handy Electric "Combination" Lock for Drawers, Tool Boxes, Etc.

Contributed by A. R. DARLING.

An Electro-Magic Skull

By Homer Vanderbilt

MOST readers of this journal are undoubtedly familiar with the "rapping skull" used by stage magicians, but are possibly doubtful as to how it really works. Several of these schemes

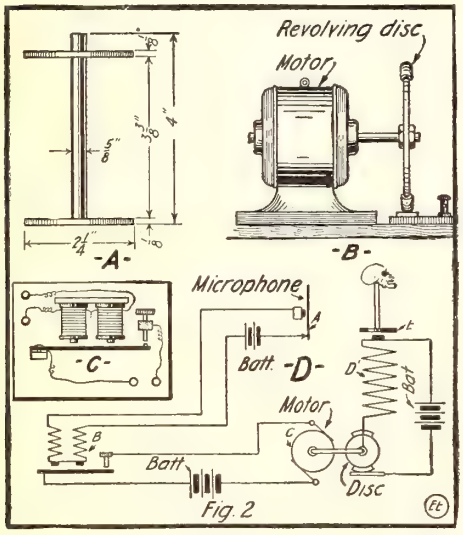


Fig. 2. Circuit Arrangement for the Mystic Skull.

have been developed by different workers in the field, and one of these is herewith described in detail.

The general principles upon which this trick works are as follows: A sensitive microphone, A (Fig. 1), of the *carbon ball type*, is connected in circuit with a relay, B (see also Fig. 2, D), and its armature circuit is linked with a motor, C, and battery. Upon the motor shaft a proper circuit breaker is placed and the latter is connected in series with a powerful electro-magnet, D^1, actuating an iron armature, E, which is connected to a rod, F, operating lever G, which is fastened to the (balanced) lower jaw of the skull, as perceived. Now, when you speak or produce any sounds near the instrument, the microphone will be disturbed, operating the relay, which will connect and work the motor, and in turn the circuit breaker. Consequently the electro-magnet D^1 is put in operation and the result is that the jaw is pulled up by the action of the rod F, actuated by the magnet. When the current is released the slightly overbalanced weight of the jaw will cause it to drop back. The arrangement herewith shown will only cause a double rap of the jaw, but the number of them may be varied by increasing the number of segments on the circuit breaker.

The writer will unfold the details of his apparatus and thereby the experimenter will be enabled to build such a device for amusing his friends. It is certainly very amusing to witness the astonishment of the visitors when the skull is operated.

The constructional details of the individual apparatus are shown in Fig. 2. The electro-magnet "A" is made to size, as perceived, and is fully wound with No. 22 B. & S. copper magnet wire. The circuit breaker "B" consists of a disc revolved by a motor and which makes contact with a brass strip located at the bottom of the base, as depicted. The relay "C" is made of two bell magnets actuating an iron armature carrying a contact point which coacts upon a second point, as seen. Connections for the various parts are shown in drawing "D." Practically any kind of relay can be advantageously used. The transmitter is of the supersensitive type and which can readily be made by following the instructions given in the November, 1915, issue of this journal on page 333 in an article entitled "How to Build a Dictaphone." After these various instruments are made they should be properly arranged as portrayed in Fig. 1 and connected as shown in "D," Fig. 2. The instrument is now ready to be used. The only thing necessary to operate the jaw of the skull is to talk or blow a whistle, which will affect the transmitter and in turn the jaw, thereby causing it to rap very mysteriously.

In conclusion several points may be mentioned which if followed will make the apparatus work and appear much more professional. Firstly, the contact disc had best be geared up to the motor, so that it makes about one revolution to 20 or more of the motor shaft. Again, the skull should be arranged so that it may be picked up from the stand and shown to the audience. At Fig. 3, "E," is indicated how a separable rod joint, X, may be contrived, enabling the operator to remove the skull easily for inspection. An indirect electrical method is the best way in which to actuate the jaw. At Fig. 3, "G," is perceived how the electro-magnet D may influence magnetically an iron disc, X_2, joined to the movable jaw, as usual, by a lever or wire. This

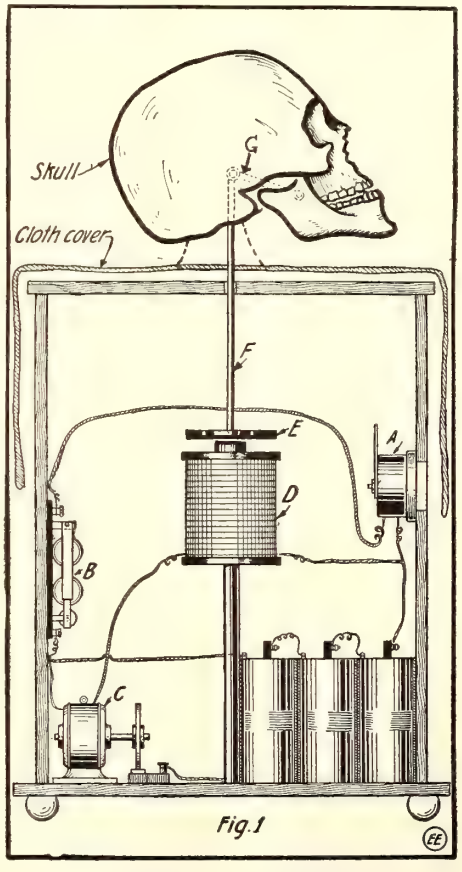


Fig. 1. Assembly Details of Mystic Skull in Cabinet.

permits of minute inspection by the audience. Again, the effect can be attained by placing an aluminum ring in the jaw (properly balancing the jaw to make it work easily) and an alternating current electro-magnet, by induction, will repel the ring (and hence the jaw also) whenever it is energized.

These latter schemes are merely suggestions that may be used to give the apparatus a professional appearance. A final word; it is absolutely necessary to mount the cabinet on a solid support, otherwise vibration will cause it to operate of its own

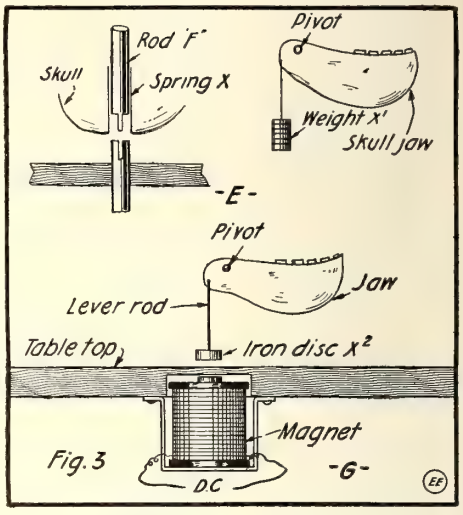


Fig. 3. Details of Jaw Actuating Mechanism.

accord and spoil the whole illusion.

VALUE OF RADIO TO VESSELS IN DISTRESS.

During the fiscal year 1915 the radio inspectors of the United States Navigation Bureau reported 26 cases of vessels leaving our ports which met with accident or disaster, requiring the use of wireless to summon assistance. Four of these were from fire; 12 were from running ashore, stranding, or getting into an ice jam; 3 were from the breakage of machinery; 4 resulted from collisions; 1 from shifting of cargo; 1 vessel was storm-battered and waterlogged; and 1 was torpedoed. Excepting in the case of the "Lusitania," which was torpedoed, the assistance thus rendered resulted in but two lives being lost. Since the close of the fiscal year the following disasters have occurred:

On Sept. 13, 1915, the Fabre Line steamship "Sant' Anna," bound from New York to Naples with 1,700 Italian reservists and crew aboard, caught fire in mid-ocean and all persons on board were saved. The S O S call brought the steamship "Ancona" to the assistance of the disabled vessel and 600 persons were taken off. The "Sant' Anna" then proceeded to port, convoyed by the "Ancona," and the entire 1,700 passengers and crew saved.

Six days after the "Sant' Anna" disaster, the Greek liner "Athinai," bound from New York to Piraeus, caught fire in mid-ocean and was abandoned by the passengers and crew, numbering 470. The call for assistance was answered by the steamships "Tuscania" and "Roumanian Prince"; 341 persons were taken on board the "Tuscania," the remaining 129 being taken off by the "Roumanian Prince." The vessel was entirely destroyed.

The use of radio apparatus on vessels carrying passengers, or with 50 or more crew, is now accepted as essential to the safety of those on board, and the report of the "Athinai" shows conclusively that many persons might have been lost and perhaps the cause of the disaster never known had not this vessel been equipped with radio apparatus.

How to Build a Photophone

Those who are experimenting with selenium will find this manometric flame very useful in their research work. It can be employed in transmitting wireless telephone messages by the use of a light beam acting upon a selenium cell. It can also be successfully employed in recording voice sounds by the addition of a revolving mirror.



Fig. 1. The Completed Photophone.

The complete apparatus as shown in Fig. 1 was built by William J. Hammer, of New York. A selenium cell is placed behind the flame-tip as perceived and is connected in series with two batteries and 'phones, as photograph shows. In Fig. 2 the constructional details are given. The very first thing to build is the stand, which consists of two strips of well-seasoned wood of either oak or mahogany. It should be made of ¾-inch stock, and the details of same are given in both figures.

The most important apparatus of this outfit is the instrument A, which causes variations in the flame at the tip, and this is made from an old shoe blacking can. The can is first thoroughly cleaned by applying hot water and a rag; after this is done a 1-inch hole is made in the cover, as seen in Fig. 2. This can be made by either drilling or else sawing it out with a jeweler's saw. A $\frac{5}{16}$-inch hole is drilled in the center of the back for securing a brass tube B. This tube should be well soldered on the back and is used for transmitting the gas to the tip. Another tube C of the same size is secured on the bottom of the case, and this also should be soldered, and is connected to an acetylene gas generator by means of a rubber tube. The diaphragm is next provided, which consists of goldbeater's or pig's bladder skin of very light quality. First the latter is laid across the case with its cover removed and the skin is then tightly stretched across the edge of the box, and finally the cover is placed over the diaphragm. This is firmly pressed into its proper place. The edge of the cover is next soldered all around the case in order to make it perfectly gas-tight.

Having finished all this, a hole is made in the upright wooden standard 10 inches from the bottom and 2 inches from the side. The tube B is now carefully inserted through this hole and firmly held in place by applying some sealing wax around the tube. An ordinary acetylene gas tip is procured and placed over the end of the tube as observed.

A small selenium cell is now placed in back of the flame tip. This is held in position by means of two brass strips, which are screwed on to the base by wood screws. Two binding posts are next placed on the upright support and these are connected to the cell, which in turn is connected in series with a telephone receiver and several batteries, as the photograph depicts.

The experimenter who is not familiar with the working principle of this instrument will find the following simple explanation quite satisfactory: At first, when the gas enters the chamber, a straight flame is produced at the tip; but as soon as one begins to talk near the diaphragm at A the volume of gas is interrupted, and consequently the flame is varied in brilliancy, this being directly proportional to the intensity of the sound against the diaphragm. Therefore the change in the voice will be reproduced in the flame, and in consequence will affect the sensitive selenium cell, which then operates the telephone receiver according to the variation of resistance. As this is governed by the gas flame, therefore the voice is accurately duplicated at the receiver by merely talking against the skin diaphragm. Of course, it should be understood that the selenium cell can be placed at any distance from the flame, light will be required. This principle, greatly enlarged upon, as by using an electric arc lamp, has enabled speech to be transmitted for several miles; one record attained by the late Herr Ruhmer having been 14 miles.

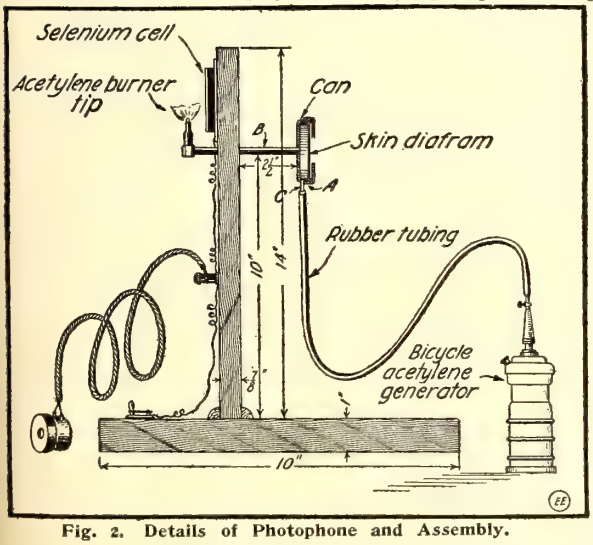
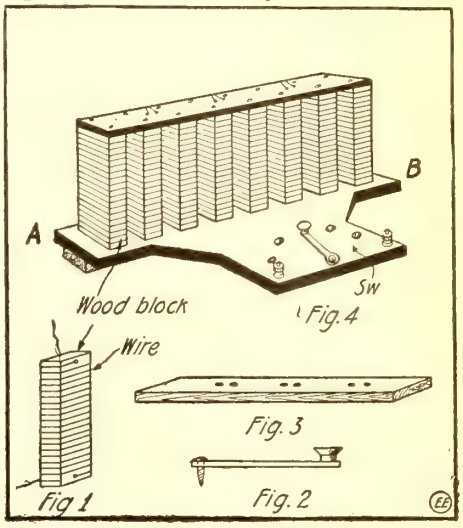


Fig. 2. Details of Photophone and Assembly.

RHEOSTAT FOR SMALL MOTORS.

This rheostat is composed of a base-board, eight hardwood blocks and a strip of wood for the top piece, used as a binder. The blocks are ¾ inch thick, 1½ inches wide and 4 inches long. A hole is made through both ends of the block, through which one end of wire is passed. The wire is then wound around the block, taking care to wind it evenly and leave about ⅛ inch between each strand. Put the wire through the opposite hole and clip it off, leaving just enough wire so that connections may easily be made. This step is shown in Fig. 1.

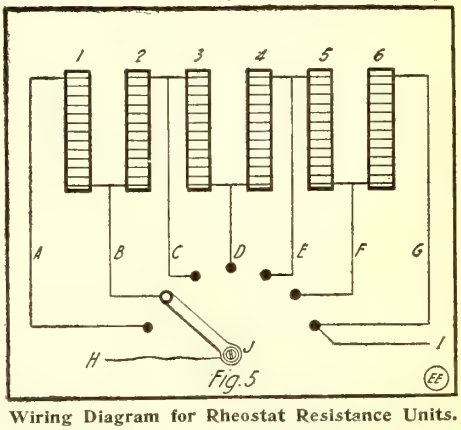


Parts and Assembly of Rheostat for Controlling Small Motors.

When the eight blocks are wound mount them at the rear on the base-board; cut in the design shown in the drawing, the rear measuring 9 inches from A to B in Fig. 4. Screw the strip to each one of these blocks as shown in figure. The switch may be made of suitable metal 3 inches long, ½ inch wide. At one end glue half of a spool as shown in Fig. 2. When completed it should look like Fig. 4.

The connections are made as follows: Coil Nos. 1 and 2 are connected at the bottom, Nos. 2 and 3 are connected at the top, and so on to the end. The leading-in current is connected at pole H, and so on to J, while the leading-out wire is made fast to pole I.

The switch arm is moved over to the first contact point, which starts the current through wire A down through coil 1, up coil 2, down coil 3, up 4, and thus through 6 and out wire G. Should this offer too much resistance, move the switch to contact 2, which sends the current through wire B, up through coil 2, down 3, up 4, etc., and thus out wire G.

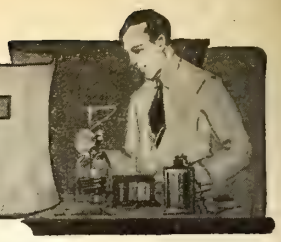


Wiring Diagram for Rheostat Resistance Units.

The contact points and binding posts may be made or bought at very low cost.

Contributed by JACK CRANDALL.

HOW TO MAKE IT



This department will award the following monthly prizes: FIRST PRIZE, $3.00; SECOND PRIZE, $2.00; THIRD PRIZE, $1.00.
The idea of this department is to accomplish new things with old apparatus or old material, and for the most useful, practical and original idea submitted to the Editors of this department, a monthly series of prizes will be awarded. For the best ideas submitted a prize of $3.00 will be given; for the second best idea a $2.00 prize, and for the third best a prize of $1.00. The article need not be very elaborate, and rough sketches are sufficient. We will make the mechanical drawings.

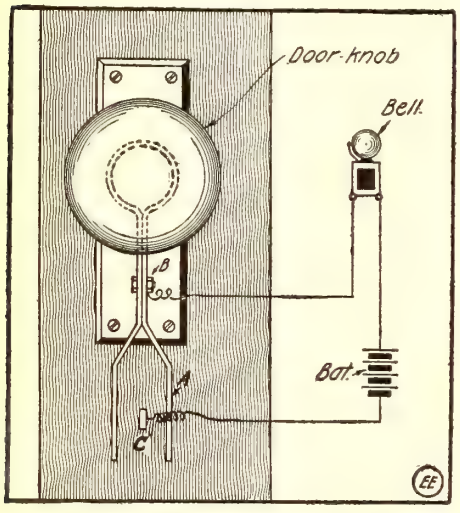
FIRST PRIZE $3.00.

A SIMPLE DOOR BELL ALARM.

An easily made switch for ringing a bell to let me know when anyone opens the door of my shop is here described.

A metal strip (A), preferably of copper, should be bent into a small circle at the middle to fit over the doorknob bar. A small bolt will draw it up tight around this bar at (B). Place between the prongs and fasten to the door a metal strip (C) and the device is complete.

By connecting a battery and bell as shown a slight turn of the knob either way will throw one prong or the other against (C), completing the circuit and ringing the bell.



Electric Call Bell Attachment for Door Knobs.

Contributed by C. REX GILBERT.

METHOD OF THREADING HOLES IN CARBON AND OTHER MATERIALS.

The following is a suggestion for threading holes in pieces of carbon and other material without taps. Bore a hole in the carbon a little deeper and with a larger diameter than the length and diameter of the screw you intend using. Then nick the edge of the hole with a file or saw. Melt sufficient lead to pour into the hole, and while the lead is still in a molten state insert the screw. When the lead has hardened the screw may be removed with a screw-driver.

Contributed by PHIL TAUB.

THE INITIAL STEP.

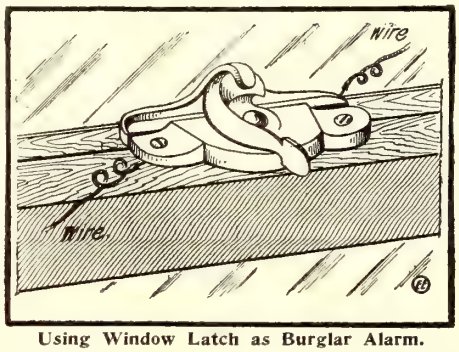
"I hear, old man, that you are going in for wireless. What have you got toward it?"

"A catalog, two binding posts and a buzzer."

SECOND PRIZE $2.00.

USING WINDOW-LATCH AS A SWITCH.

A window-latch can be used as a single-pole, single-throw switch by connecting your wires as shown in the diagram or by



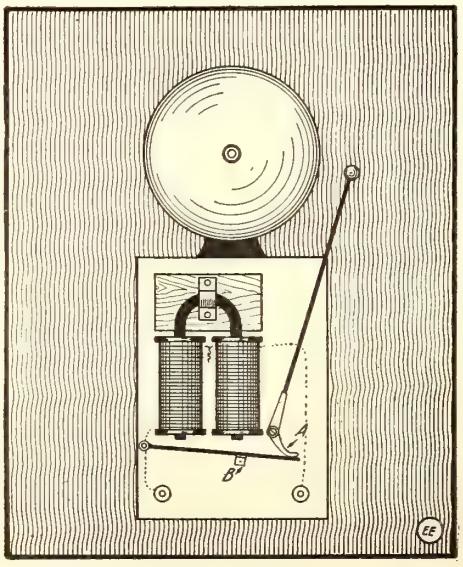
Using Window Latch as Burglar Alarm.

connecting the wires as on an ordinary single-pole, single-throw switch. The latch may be of any metal. This is useful for closed-circuit burglar alarm circuits.

Contributed by BERNARD COHEN.

A SOMEWHAT DIFFERENT ELECTRIC BELL.

The bell herewith illustrated is very simple, but a few words may make its construction clearer. It differs from the ordinary style of bell in that it has a hinged armature instead of a spring one. The clapper holder A is made from a piece of heavy copper. A hole is drilled and tapped



An Electric Bell of Radical Design.

to take an 8-32 brass machine screw. A further hole is then made in the base into which the screw will fit very tightly. Before putting the clapper holder on a brass nut should be put on the screw for convenience in making the connection. In operation the bell works as follows: When a current flows through the magnets the armature is drawn up against the pole pieces which actuate the clapper. When the clapper strikes the bell the arm of A should just barely be clear of the armature, thus breaking the circuit. The armature drops back before the clapper and when the latter drops the circuit is again completed.

Contributed by SELMER WICK.

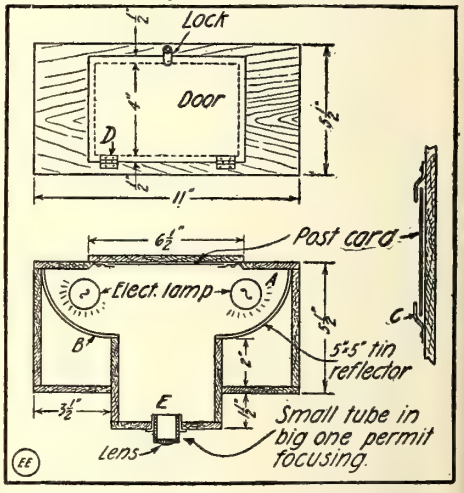
THIRD PRIZE $1.00.

POST CARD PROJECTOR.

The materials required for this device are two electric lamps and two sockets. Also two pieces of tin 5x5 inches, "B"; two strips of tin 1x4 inches, "C," bent as shown; two small hinges, "D"; a lens having about 5 inches focal length, "E," and some pieces of hard wood.

From the hard wood construct a box 11 x5½x5½ inches, as shown in illustrations. Then put the lamps, reflectors, lens, door with post card holder and hinges on same and connect lamps with batteries. To operate put the postal or other picture in holder, close the door and take the machine into a dark room. Then hang a curtain 7x5 feet on the wall and focus the lens.

Contributed by ARTHUR PAUL.



Home-Made Post Card Projector.

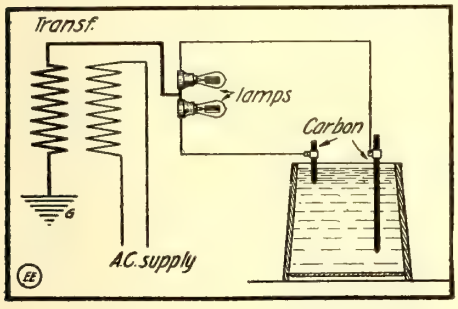
DRY CELLS SHOULD BE DATED.

Dry batteries are useful for many experimental purposes, but have the disadvantage of giving no external indication of being run down. It is a good plan, therefore, to label each cell with the date on which it was put into use. This is especially useful in connection with electric bells, for if a defect occurs one must suspect either the bell, the battery or the wiring. If the battery is seen to have been in service for a long while, it will be advisable to try a new cell rather than spend much time testing the wires or adjusting the bell.

Contributed by H. J. GRAY.

AN ELECTRICAL WATER LEVEL INDICATOR.

A novel form of electrical water level gauge is described by a writer in *Power*. This arrangement is particularly adapted to gauge the depth of water in shallow pans or reservoirs, where, for instance, the total depth is only 5 inches from the overflow outlet to the bottom of the pan. A float of the usual type was tried, but found to be impracticable. As the illustration shows, a 200-watt, 2-coil A. C. transformer was connected with a pair of lamps, which were in turn connected in multiple to the water level in the pan. The terminals in



Unique Water Level Indicating Scheme.

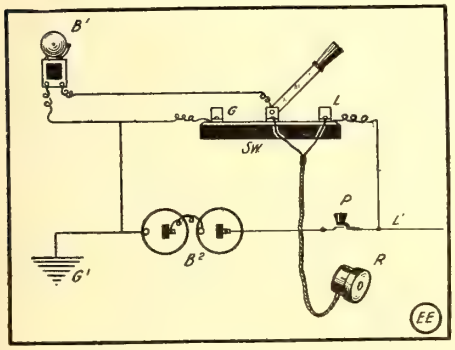
the tank were a pair of arc lamp carbons, one having been adjusted to make contact with the water just before the pan became dry. One side of the transformer was grounded as perceived. One of the lamps was red, while the other was left plain; a red light indicating *overflow*, while a white light denoted *safe water level*. No light indicated *no water* in the tank.

A SHORT DISTANCE TELEPHONE.

Chums can communicate with each other very easily, using the following system, provided the distance between their houses is not much over 200 feet or so.

Connect the following apparatus according to the diagram: B^1, electric bell; Sw. S. P. D. T. switch; R, 75-ohm telephone receiver; B^2, batteries; P, push button; G^1, ground (connected to water pipe); L^1, line or wire running from one house to the other.

Operation: When the phones are not in



A Simple Short Distance Telephone Set.

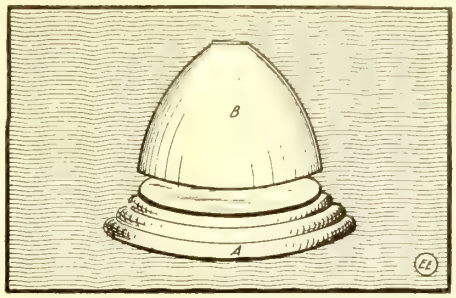
use place the blade of switch on L. Now if you wish to talk to your friend push the button P several times and then throw the blade to G. Your friend, hearing the bell, also throws his blade to G and says, "Hello!" through the receiver R, and you hear the reply in your receiver. (This being used both for transmitter and receiver.)

When the conversation is over the blades of Sw. must be thrown back to L, making the line ready for calling again.

Contributed by JAMES R. HOPKINS.

HOW TO MAKE A PARABOLIC REFLECTOR.

When making up electric bicycle headlights, etc., amateur mechanics are in need



Parabolic Reflector Made from Brass Fixture Canopy.

of a parabolic reflector, which can be made very easily as follows:

Procure from any dealer in electrical supplies a brass fixture canopy of the size required and cut off part "A" as shown in illustration. Part "B" will then serve as the reflector. Then polish the interior and proceed to silver-plate same. A silver-plating fluid can be made by dissolving 1 ounce nitrate of silver in 12 fluid ounces of soft water and adding 2 ounces cyanide of potash. Mix this with enough fine whiting to make it the consistency of thick cream, and with a piece of clean rag or cotton apply same to the polished interior of your reflector. Let it dry and brush off the whiting and you will have a good, silver-plated parabolic reflector.

Contributed by GEO. NIEDERHOFF.

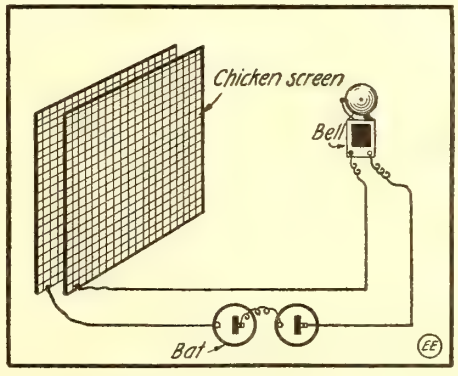
A SAFETY CHICKEN-COOP.

If one has a chicken-coop and is troubled with chicken thieves, he may avoid this by constructing a safety coop.

Take an abundance of wire screen and surround the coop with it. Fasten it to the ground so that it is firm. Then take another screen of the same length and fasten it to the ground so that it is about 1 inch away from the first screen. Take batteries and a bell and connect them with the screens as the diagram shows. Whenever a thief comes to eliminate some of your fowls, he brushes up against the outside screen or leans against it, and thereby closes the circuit, ringing the bell which may be located at any desired place.

Contributed by J. MARCHETTI.

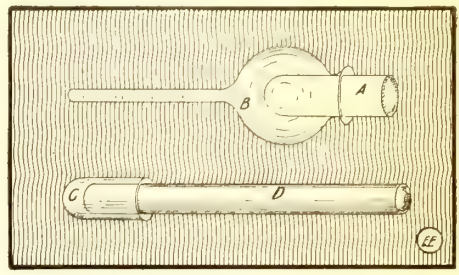
(The author of the above doesn't state what happens when a strong wind blows or when a "non-burglar" accidentally leans against the fences! Ed.)



Pressure Against Outer Screen Rings Bell of this Chicken Thief Alarm.

EXCITER FOR CHARGING ELECTROSCOPES.

It is often necessary to test the polarity of an electrostatic charge by means of an electroscope that has been charged with electricity of known sign, either positive or negative. When the charged body which is to be tested is brought near to the instrument the leaves diverge more widely if the sign is the same, or collapse if it is opposite. The usual method of giving the initial charge to the electroscope by induction is inconvenient, because the induced charge is of opposite sign to that of the charging body. By use of the device shown in the illustration either a positive or negative charge may be given direct, and, while strong enough for the purpose, there is no risk of tearing the gold leaves by over-charging.



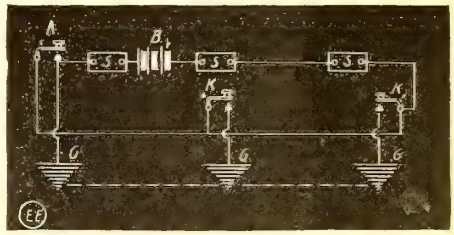
Miniature Static Generator for Exciting Electroscopes.

A thin brass tube A closed at one end is attached to a glass handle B with a little elastic glue or other non-conducting adhesive. A broken "thistle" funnel with the stem cut short and closed in a blowpipe flame makes a capital handle. The open end of the tube must be rounded, or what amounts to the same thing from an electrical point of view, turned in so that the sharp edge is inside. This must be lined with fur, the skin side of the fur being secured to the metal with glue. A smaller metal tube C, similarly rounded at the open end, is secured on the end of a glass rod D, which serves as an insulating handle. Mark the large tube "positive" and the small one "negative." The small tube should be kept inside the larger one when not in use. If quickly withdrawn both become oppositely charged, and either may be used for charging the electroscope or for any other purpose requiring a very weak charge of known sign.

Contributed by H. J. GRAY.

UNIQUE TELEGRAPH SYSTEM.

I thought that it might be of interest to some readers to know that around Spo-



Telegraph System Utilizing Three Sounders and Common Battery.

kane, Wash., some of the farmers use the wire fences for private telephone lines.

The following connections were used by three of us boys on a telegraph line. In the diagram herewith, S.S.S. are sounders, K.K.K. the keys, F.F.F. the ground connections, and B is a battery of either wet or dry cells. The chief advantage of this is that there are no switches, also it is an open circuit system.

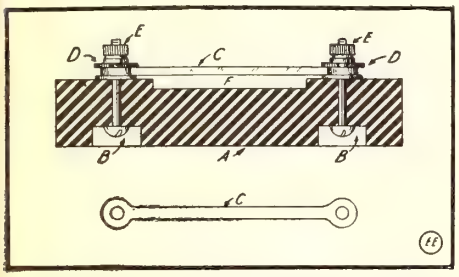
Contributed by JOHN B. MOORE.

. Shaking the transmitter will oftentimes improve the enunciation on the telephone.

FUSE FOR BATTERY CIRCUIT.

While a fuse block is not essential for a battery circuit, there is a certain satisfaction in following out the general plan of large power stations, where a properly proportioned fuse is quite indispensable. The illustration shows a simple fuse block that can be made by any experimenter, the fuse itself being quickly renewed when necessary.

The several parts are mounted on a block of wood A that has been well impregnated by soaking it in melted paraffine wax. Two



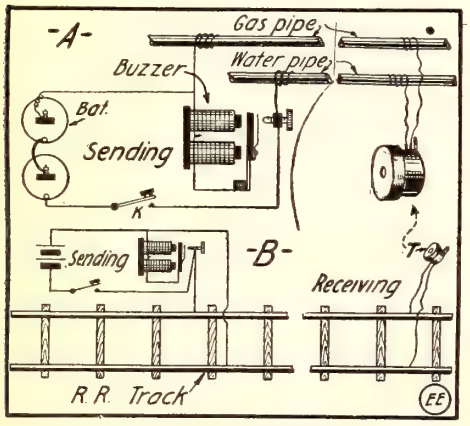
Tinfoil Fuse and Block for Battery Circuits.

bolts B, B, are passed through the underside, the holes being countersunk to accommodate the heads. The bolts may be an inch apart, and serve to hold a strip of tinfoil C, two brass washers shown at D being used to avoid tearing the foil when tightening up the nuts E, E. The strip of foil should be of uniform width, except at the ends, one-eighth inch or less being sufficient for the middle portion. If a small strip of glass F can be cut from an old negative or microscope slide and let into the wood between the bolts it will be an advantage.

Contributed by H. J. GRAY.

BUZZER TELEGRAPHS TWO MILES.

In the October issue of your magazine I noticed in an article where an English experimenter had sent messages over water pipes for one-quarter of a mile. He used a



Telegraphing by Buzzer.

sensitive galvanometer to receive signals with.

My method is cheaper and more efficient. I use a common buzzer and an ordinary 75-ohm telephone receiver. Both gas and water pipes are used, and the danger of a short-circuit by using only water pipes is averted.

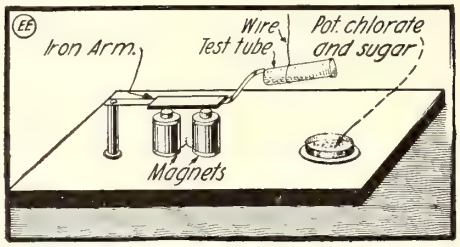
Connect the instruments as at A. The signals come in exactly like wireless buzzes. The farthest distance we ever tried was 1¼ miles, and the signals came in loud and clear.

We also tried this method along the railroad tracks B, and it worked over a distance of two miles.

Contributed by B. SCHUMM.

AN ELECTRIC IGNITER.

This apparatus is intended for the experimenter who does not possess a spark coil with which to ignite fireworks or chemicals at a distance. First wind two small magnets with No. 20 D. C. C. wire



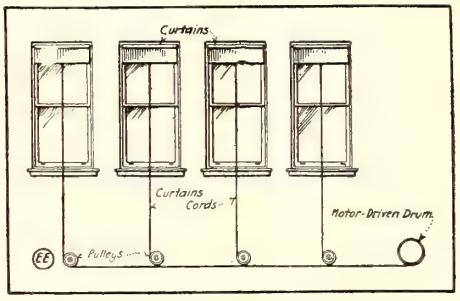
Useful Electric Igniter Subject to Remote Control.

and make an iron armature with a spring brass arm and a clip on the end of the armature. This clip holds the test tube from overturning. When clip is released, gravity upsets the tube which contains a few drops of sulphuric acid. This falls on a mixture of potassium chlorate and sugar. Take equal amounts of sugar and potassium chlorate. This mixture ignites and sets fire to a fuse.

Contributed by ROBERT CHANDLER.

MOTOR RAISES AND LOWERS WINDOW CURTAINS.

A unique device for raising or lowering

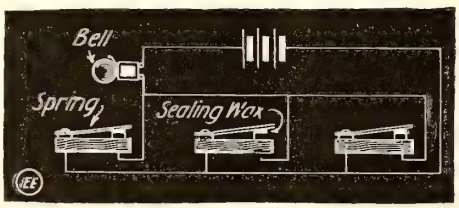


Raising Window Shades by Motor.

a number of window curtains has been adopted by a large Western school, says a writer in the *Electrical World*. As perceived, each curtain has a cord secured to same, and these all pass over a series of pulleys down near the floor, and the cords, in turn, pass to the motor-driven drum, as indicated in the illustration. In this way a few turns of the motor will lower or raise the curtains, according to the direction in which the motor is driven. These refinements are not, of course, practical in the ordinary house or hall, but in school or other buildings where there are a large number of windows which are to have their shades repeatedly changed during the day this scheme should find considerable favor.

AN AUTOMATIC "FIRE" ALARM.

This device is very practical for giving an alarm of "fire" in any room or shop. It works on the same principle as the fuse;



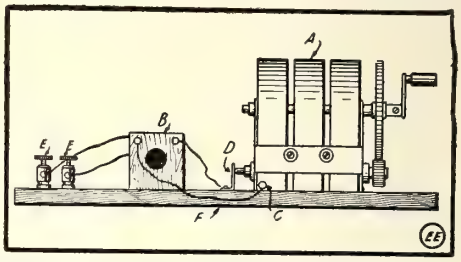
Electric Fire Alarm Using Sealing Wax Fuses.

a bit of sealing wax being used to break the circuit. With very little heat, the wax is melted, the steel spring then snaps down on the conductor terminal, thus completing the circuit and the alarm is sounded.

Contributed by WILLIAM WILLIAMS.

A HANDY A. C. GENERATING SET.

I give herewith brief description of a useful A. C. electric generator which can be made from the parts of an old telephone. Referring to the diagram A is a telephone magneto, B a telephone induction coil to step down the high voltage of the magneto to that of small motors, battery lamps, etc. One of the secondary



Small A.C. Generating Plant with Transformer.

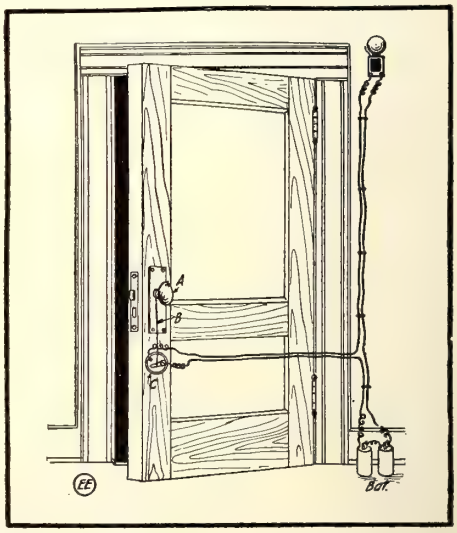
wires of the coil is connected to the contact D, the other to the magneto frame. The primary wires are connected to the binding posts EE. The base is of wood and should be of a suitable size. If the generator is run by a motor small induction coils can be operated nicely.

Contributed by AN EXPERIMENTER.

A SIMPLE BURGLAR ALARM.

This simple burglar alarm can be attached to any door with very little trouble. A string, B, is fastened to the knob, A, by winding it around the knob a few times then tying. The string is then attached to a switch, C, which makes a circuit with the contact when the knob is turned.

Contributed by CARL HANCOCK.



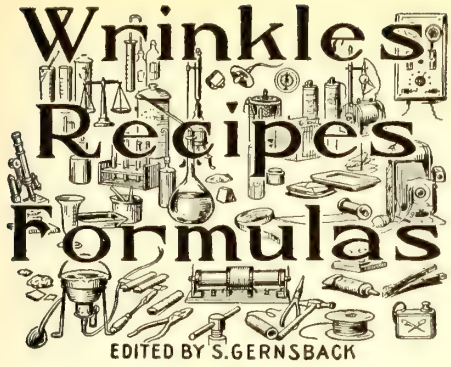
Burglar Alarm Employing String to Connect Doorknob and Switch.

REPAIRING SMALL TUNGSTEN LAMPS.

Don't throw away your burned-out flashlight bulbs. If the bulb itself is not cracked or broken connect it across the secondary of a ¼ or ½ inch spark coil and close the primary circuit for an instant, *not longer*. When you test your lamp on a battery circuit you will find that the two ends of the filament have been welded together and the light is as good as new.

(This does not always work, but it is worth trying.—*Editor.*)

Contributed by C. M. CROUCH.



Under this heading we will publish every month useful information in Mechanics, Electricity and Chemistry. We shall be pleased, of course, to have our readers send us any recipes, formulas, wrinkles, new ideas, etc., useful to the experimenter, which will be duly paid for, upon publication, if acceptable.

FORMULA NO. 19.

Blackings and Polishes for Leather Harnesses, Etc.

1. *Harness Blacking.*—Melt together 2 oz. of *Mutton Suet,* 6 oz. of *Beeswax.* Add 6 oz. of *Sugar Candy,* 2 oz. of *Soft Soap,* 2½ oz. of *Lampblack,* ½ oz. of *Powdered Indigo.* Mix thoroughly and add ¼ pint of oil of turpentine.

2. *Harness Blacking.*—Melt together 4 oz. of *Gelatin,* 3 oz. of *Gum Arabic,* ¾ pint of *Water.* Add when dissolved 7 oz. of *Molasses,* 5 oz. of *Fine Powdered Animal Charcoal.* Heat gently, stirring all the time until the compound is of proper consistency when cold. Must be kept corked.

3. *Polish for Carriage Harness.*—Dissolve 3 sticks of black sealing wax in ½ pint of *Alcohol* and apply with a sponge.

4. *French Blacking to Restore Soiled Harness.*—Take 4½ lb. of *Stearine* in thin sheets. Mix with 6¾ lb. of *Turpentine.* Heat in a water bath, during continual stirring; then add 3 oz. of *Animal Charcoal,* place the whole in another vessel and stir so as to prevent its crystallization. It must be warmed when using and rubbed on with a cloth as quickly as possible, giving it a very thin coat, and when nearly dry polish with a silk cloth.

5. *Waterproof Harness Paste.*—Put into a glazed vessel and melt over a fire 28 oz. of *black resin,* when dissolved add 3 oz. of *Beeswax.* When this is melted remove from the fire and add ½ oz. of fine *Lampblack,* ½ drm. of *Prussian Blue in Powder.* Stir well together and add *Turpentine,* enough to form a thin paste. Allow to cool. Apply with a sponge and polish with a soft brush.

6. *English Ball Blacking for Harness.*—1 oz. of *Lard,* 1 oz. of *Beeswax,* 8 oz. of *Ivory Black,* 8 oz. of *Sugar,* 4 oz. of *Linseed Oil,* 2 oz. of *Water.* Melt the wax and stir in the other ingredients, and when cold roll into balls and use.

7. *Vaseline Harness Composition.*—¾ oz. of *Prussian Blue in Powder,* 4 oz. of *Lampblack,* 2 oz. of *Molasses,* 2 oz. of *Soft Castile Soap.* Warm and mix together in a mortar. Then add 6 oz. of *Vaseline,* 5 oz. of *Ceres,* ½ oz. of *Yellow Resin.* Melt together and add sufficient turpentine to give proper consistency. Mix thoroughly.

8. *Oil for Farm and Team Harness.*—Melt 3 lb. *pure Tallow,* but do not heat it up to a boil; then pour in gradually 1 lb. neatsfoot oil, and stir until the mass is cold. If properly stirred, the two articles will become thoroughly mixed and the grease will be smooth and soft; if not well stirred, the tallow will granulate. Add a little bone black for coloring.

9. *Lacquer for Harness.*—5 parts of *Colophony,* 1 part of *Lampblack,* 2 parts of *Mastic,* 5 parts of *Sandarac,* 20 parts of *Shellac,* 5 parts of *Turpentine,* 100 parts of best *Spirits.*

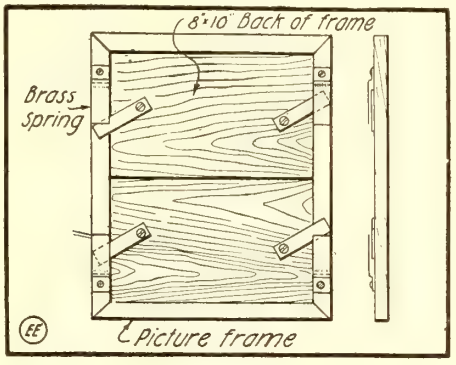
10. *For Russet Leather Harness.*—Mix together 1 part of *Palm Oil,* 3 parts of *Common Soap,* and heat up to 100° F., then add 4 parts of *Oleic Acid* and 1¾ parts of *Tanning Solution* (containing at least 1-16 of *Tannic Acid.*) Stir until cold.

S. G.

EMERGENCY BLUE-PRINTING.

Recently I had occasion to make a blue-print drawing in a hurry, but found I did not have either a frame or the blue-print paper large enough for the work at hand, so the following kinks may come in handy for some readers of your magazine. To make the frame I took down a picture from the wall and removed everything except the glass and frame. I then screwed four pieces of spring copper on it as shown in the drawing. The size of the picture frame was 16x20 and, having two backs for the regular 8x10 photographic frames, I fixed them up as shown. This frame proved to be very serviceable and filled the requirements which were needed.

To make the blue-print paper proceed as follows: Obtain a fairly good grade of drawing paper (Rives or Saxe paper, if it



Making an Emergency Blue-Printing Frame of Large Size.

can be obtained), and cut down to the required size. Next make up a blue-print solution as follows:

Solution A.—Water, 2 ounces; potassium ferricyanide (red prussiate), 120 grains.

Solution B.—Water, 2 ounces; ammonia citrate of iron, 140 grains. (Any proportion of the above can be made.)

When they are thoroughly dissolved, mix and filter, and always keep in a clean bottle. Be careful not to let too much strong light act upon this solution.

The best way to sensitize the paper is to work by an orange light similar to the light used in bromide printing in photography. Float the paper on this solution until it lies perfectly flat. Do not take it out of the solution carelessly, but slide it out by grasping two corners, sliding it over the surface of the water. If it is desired to keep some of the paper for future use this can be done by rolling it up, with the sensitized surface on the inside, and keeping in a tin box free from light.

If any part of the above instructions are not clear I shall be very glad to try and explain anything in doubt upon receipt of a self-addressed envelope.

Contributed by A. WILSDON.

To Remove Oil Stains from Leather.—Cover the spot with *Spirits of Sal-ammoniac;* allow it to act for a short time, cleaning with clear water; repeat until the spot is removed, taking care not to affect the color of the leather.

A GOOD SILVER WASH.

Take 1 ounce of pure nitric acid, 1 silver dime (or, better, a Canadian five-cent piece, which is also silver) and 1 ounce of quicksilver. These ingredients are now placed in a glass vessel and left until they are completely dissolved. Then add a pint of water and next enough powdered whiting to make the whole into a powder. This silver wash may be used on brass, copper, German silver, etc.

CEMENT FOR ATTACHING GLASS TO METAL.

Take about 2 ounces of a thick solution of glue and mix with it 1 ounce of linseed oil varnish and ½ ounce of pure turpentine. This mixture is next boiled in a covered crock and is then ready for use. The articles after being cemented should be clamped together for several days to allow the cement to set properly.

A GOOD SOLDERING SOLUTION.

Procure about 5 cents' worth of muriatic acid and add as much pure zinc as it will dissolve. If a little rain-water is added it will somewhat improve the mixture. The articles to be soldered should be thoroughly cleaned of every trace of dirt. The soldering solution is next applied with a wire brush to the cleaned surface. With this solution the solder will stick every time.

Contributed by WM. A. CAWLEY.

SILVER PLATED PENNIES.

In a solution of mercuric nitrate place a cent so that the coin will be completely covered by the liquid. A chemical reaction immediately takes place; the copper, having a greater affinity for the nitrate than the mercury, forms a copper nitrate, causing the mercury to be deposited on the cent, which gives it a silver-plated appearance.

If mercuric nitrate cannot be bought it can easily be made by dissolving a small globule of mercury in a little concentrated nitric acid, warming, if necessary, to start the reaction.

Contributed by PAUL JENKINS.

HOW TO CUT BRASS AS WELL AS GLASS IS CUT WITH A DIAMOND.

With a quill pen dipped in a strong solution of alcoholic corrosive sublimate (*careful; strong poison*) draw a line on the brass. After letting this dry, go over the line with the pen dipped in nitric acid. Then the metal may be broken as glass is cut with a diamond.

Contributed by JOHN SCHMELZEIS.

MISCELLANEOUS FORMULAS.

A good metal polish may be made as follows: Take wood alcohol, 3 parts; aqua ammonia, 1 part; prepared chalk, ½ part. Apply the polish with a flannel and when dry wipe off. Shake the polish before using to get the chalk stirred up.

Carpet soap can be made as follows: Three small bars of good white soap, 2 gallons of water, 1 10-cent bottle of household ammonia, ½ box of borax and 10 cents' worth of tartar. Dissolve the soap in water on top of stove; then add other ingredients. Let boil 10 minutes and then remove from the stove.

A silver plating for steel can be made as follows: Lunar caustic, 11 parts; sodium hyposulphite, 20 parts; sal ammoniac, 12 parts; whiting, 20 parts, and distilled water, 200 parts, mixed together. Before applying the silver plating to the article clean off all grease.

Contributed by SAUL MARCUS.

WITH THE AMATEURS

Our Amateur Radio Station Contest is open to all readers, whether subscribers or not. The photos are judged for best arrangement and efficiency of the apparatus. To increase the interest of this department we make it a rule not to publish photos of stations unaccompanied by that of the owner. Dark photos preferred to light toned ones. We pay each month $3.00 prize for the best photo. Make your description brief. Address the Editor.

AMATEUR RADIO STATION CONTEST.

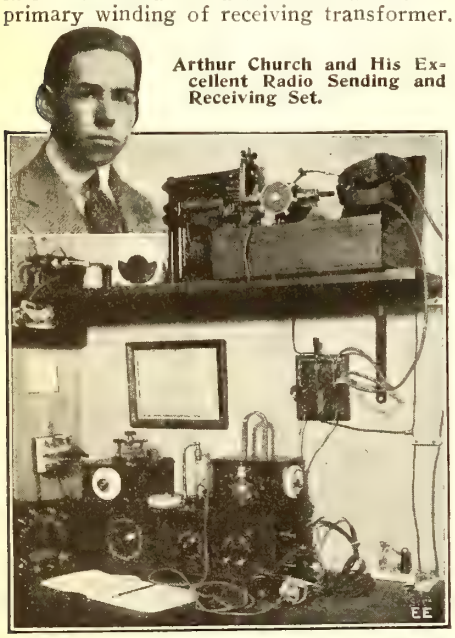
Monthly Prize, $3.00.

This month's prize winner.

ARTHUR CHURCH'S PROGRESSIVE WIRELESS STATION.

I present herewith photograph of my wireless station. The transmitter consists of a 1-K. W. Thordarson transformer and line protector, moulded condenser, rotary spark gap and hinged type oscillation transformer.

The receiving set consists of a special loose coupled tuner of my own design and construction, three variable condensers and fixed condenser, audion detectors and E. I. Co. "Government" type 3,000-ohm receivers. A pair of Brandes superior 'phones are also seen in the photo. A special switch on the left end of the cabinet throws the E. I. Co. .01 M. F. variable condenser either in series with antenna circuit or across the primary winding of receiving transformer.



Arthur Church and His Excellent Radio Sending and Receiving Set.

A Mignon vario-selective coupler is sometimes used with very good results, but is intended especially as a portable receiver in which capacity it is admirable indeed. I am using a multi-audifone equipment, and the received signal strength at this station is simply wonderful. N.A.R. comes in at noon loud enough to be read with 'phones off—a distance of over 1,500 miles. W.H.K. and several other stations are audible at times 40 feet from 'phones. Regular communication is carried on with various stations within 300 miles.

Two aerials are employed; one for 200 meter work and the other for longer wave length. The latter is 300 feet long, stretched from a 100-foot mast to a 60-foot pole at the station. I hold a second grade commercial radio operator's license and my official call is 9.W.U.

ARTHUR B. CHURCH.

Lamoni, Iowa.

LAKE PARK RADIO CLUB.

The accompanying illustration portrays some of the apparatus in use at the main station of the Lake Park Radio Club at Des Moines, Iowa.



Radio Station of the Lake Park Radio Club.

The aerial is of the "L" type and contains four wires. We can receive the following stations easily: Ames, Iowa State Teachers' College, East and West High Schools, and we also hear many near-by amateurs.

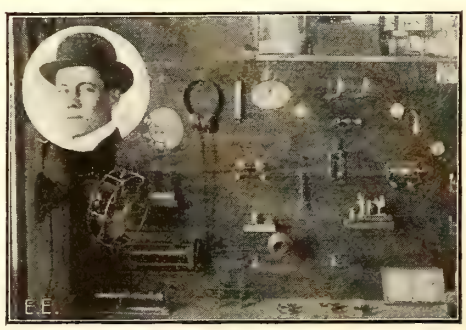
The following gentlemen hold office: Roy Smith, president; French Holebrook, vice-president; James R. Allen, treasurer; Kerby Moran, secretary.

LAKE PARK RADIO CLUB,
Per James R. Allen, Sec'y.

Des Moines, Iowa.

RADIO STATION OF CHARLIE BARE.

Herewith are presented illustrations of my wireless set and myself. I am using a one-half kilowatt, closed core transformer at present, with a quenched spark gap of my own make. The detectors are also of my own construction. My switchboard is placed 40 inches from the wall, thereby allowing space behind it for tools and materials necessary for making repairs. The aerial consists of four stranded wires, each 75 feet long and 70 feet high.



Well Arranged Station of Charlie Bare.

I am also carrying a line of wireless supplies in my office and use my station extensively for demonstrating.

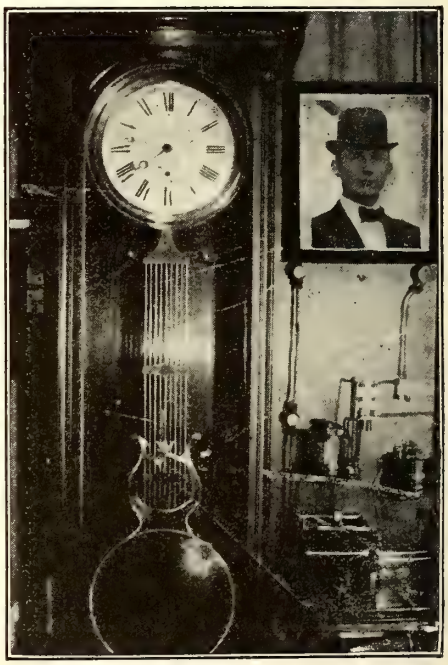
CHARLIE BARE.

Mt. Carmel, Ill.

RADIO TIME SET OF J. B. MACKEY.

About seven months ago, after having read several interesting articles in *The Electrical Experimenter* on wireless and wireless time receiving stations and being a jeweler, I became very much interested in a wireless time receiving station.

Our city gave me permission to attach one end of my aerial to the water tower, which is 110 feet high. This tower being 275 feet from my store gives me an aerial 253 feet between spreaders (I used four wires in aerial). My store is a two-story building, so I only had to erect a 70-foot mast to make it 110 feet at that end. Now comes the interesting feature to the jeweler. On top of this mast that stands 110 feet high over my store I installed a 500-watt Ruby electric light. I made a little attachment that you may notice in the



Wireless Time Station of J. B. Mackey.

picture, which I attached to the pendulum of my regulator, making a contact every time the pendulum swings back and forth, flashing the time out to the public in perfect synchronism with the time signals given out by Arlington (N. A. A.). The last minute preceding the hour of time the light is made to burn continuous by means of a two-way switch, going out absolutely on the hour. This feature of wireless time has proven a big advertisement for me, and I believe it will for any jeweler. People in a neighboring town about five miles away are able to get correct time regular as it is flashed out. This method of transmitting time has been reported as far as 15 miles from my store. Many people on the streets, when the time is being given, stop and compare their watches to the second.

J. B. MACKEY.

Uniontown, Ala.

WIRELESS STATION OF ROY WUENN.

I am submitting herewith a description and photograph of my set for the Amateur Wireless Station contest. The transmitting set consists of 1½-inch and 2-inch coils, helix, rotary and stationary gaps, two condensers (one a Leyden jar condenser and the other a glass plate type, connected together) and a key. The receiving set has a De Forest rotary variable condenser, Blitzen variable condenser, sliding plate condenser, variometer, tuning coil (800 meters), transformer (3,000 meters), transformer (5,000 meters), two fixed condensers and three detectors, galena, commercial silicon and Radioson detector. The aerial consists of six strands on 12-foot spreaders. It is of the inverted "L" type, 150 feet long, suspended between a 60-foot pole and one on top of the house.



Complete Radio Set of Roy Wuenn.

I purchased some of my instruments from the large wireless station that was at Michigan City. I have received many long-distance station signals, having caught baseball scores sent from New York to Chicago. I shall be glad to communicate with anyone within my range. ROY WUENN.

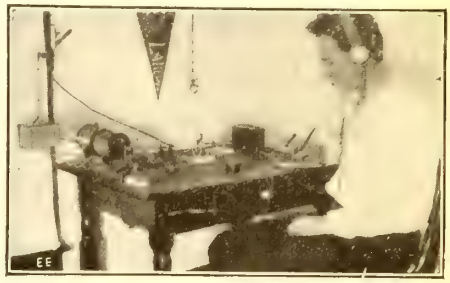
Michigan City, Ind.

THE IONIZED UPPER AIR.

The theory that the upper layers of the atmosphere are ionized and therefore conduct electricity, first suggested by the late Professor FitzGerald in 1893, has been extensively utilized in recent years to explain the law of decrease of the intensity of radio-telegraphic signals with distance. In an article in the *Revue générale des Sciences* Professor H. Nagaoka, of the University of Tokio, attributes this ionization to two causes. The first is the ultra-violet light of the sun, which he believes is capable of ionizing the atmosphere down to about 40 kilometers from the earth's surface. The second is the stream of electrons emitted by the sun, which, owing to the magnetic fields of the sun and the earth, describe paths far from straight and account for the ionization of the upper atmosphere at night. The greater height of the reflecting layer at night and the consequent reduction in the number of reflections of the waves at the ionized layer and at the earth's surface account for the better transmission of signals at night. The under concave surface of the ionized layer above a station at which the sun is rising focuses the waves from the west near the surface of the earth, and so gives the good signals at dawn. A similar focusing of the waves from the east occurs at sunset. The effect of solar eclipses is explained in the same way, and Professor Nagaoka points out that as the period of an electrical oscillation on the sun is 6.5 seconds, there should be a corresponding period in the stray signals at terrestrial stations. He hopes radio-telegraphic observers will succeed in detecting this period exactly. This opens an interesting field of experiments for the amateur interested in such work.

MAX CLINCH A RADIO ENTHUSIAST.

As I am a regular subscriber to *The Electrical Experimenter* I take this opportunity of tendering photo of my station and myself for entrance in your amateur station contest.



Max Clinch Enjoys His Wireless Outfit Thoroly.

My aerial is of the "L" type, 300 feet long, 65 feet high, composed of four strands of antenium wire, spaced 2½ feet apart.

My receiving set consists of Murdock receiving transformer, variable condenser, crystaloi detector with cohering inductance, fixed condenser and 2,000-ohm Brandes 'phones.

My transmitting outfit includes a New York spark coil, spark gap, condenser, key and 12 batteries.

I have no trouble in getting Key West and can hear Arlington 20 feet from 'phones. I get most of my ideas from *The Electrical Experimenter* and could not afford to be without it.

MAX CLINCH.

Lakewood, N. J.

Amateur News

Radio Experimenter Talks 600 Miles on 1,320 Watts.

F. M. Corlett, wire chief of the Automatic Telephone Co., at his home at 1101 East Eighth street, Oak Cliff, Texas, recently talked by wireless to the Christian Brothers' College in St. Louis. Mr. Corlett has a regulation wireless apparatus erected in his back yard which he has but recently completed.

Mr. Corlett talked to St. Louis, a distance of 600 miles, with 1,320 watts of energy, which is considered unusual. Radio engineers generally figure 10 watts to a mile, which would have given Mr. Corlett a range of only 132 miles.

He picks up the time signals from the station at Arlington, Va., and often "listens in" on powwows between the United States transport "Buford" and some Gulf of Mexico neighbor.

Radio Club of America Meeting.

Several interesting papers were delivered at a recent meeting of the Radio Club of America, held at Columbia University, New York City, Mr. Emil Simon, a noted radio engineer, read a paper on Professor Pupin's testimony in a wireless suit between the Marconi and the Telefunken Companies. He expressed his ideas lucidly on the whole subject.

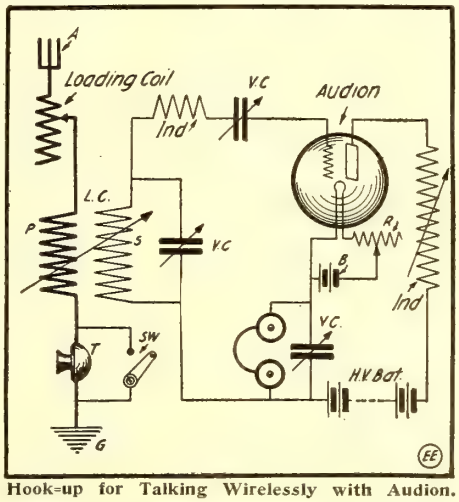
Due to the present patent litigations, no discussion was permitted after the paper was read. Chairman George Elty, one of the engineers who installed the radio telephone apparatus at Arlington, described the system and methods involved in this wonderful radio engineering achievement. He stated that the received wireless telephone message was amplified and then brought back to N. A. A. on a line.

Mr. Sadenwater, radio inspector, described a method and gave a circuit for using a regular audion receiving set as a wireless telephone transmitter and receiver and he proved with this circuit that a distance of over a quarter of a mile can be readily covered, utilizing an ordinary audion bulb. The diagram of the connections is herewith reproduced and it consists of an ordinary Armstrong hook-up, with a telephone transmitter connected in series with the ground lead. It should be understood that the audion must oscillate before it will transmit any current. By placing a short circuiting switch around the transmitter, it is possible to receive messages with the same circuit.

Mr. Whitting, president of the Worcester Radio Club, of Worcester, Mass., described in a very simple manner the exact effects that take place in a complete radio transmitter employing a quenched spark gap.

Among the members who participated in the discussion were Mr. Pacent, vice-president of the club, and Mr. Greeley.

At the December meeting Mr. William Dubilier delivered a paper on the "Construction and Operation" of his well-known direct-current vibrating interrupter.



Hook-up for Talking Wirelessly with Audion.

RADIO CLUBS ATTENTION!

We are always pleased to hear from young Edisons and Radio Clubs. Send a write-up of your Club with photos of members and apparatus to-day to: Editor "Amateur Gossip" Section, The Electrical Experimenter, 233 Fulton St., New York City.

University of Pittsburgh Reopens Wireless Plant.

The University of Pittsburgh department of electrical engineering reopened its wireless plant for public communication recently. With the cooperation of the Radio Society of Western Pennsylvania, the wireless work during 1914 and 1915 was satisfactory and a number of interesting experiments were carried on. The plant is similar in design to the immense Government station at Arlington near Washington.

An extensive program is being prepared for the spring. A number of experimental tests are to be arranged with long distance stations. A plan is being arranged whereby many university stations throughout the country will be organized into a radio society.

A large correspondence was carried on with amateurs during the past season and it is expected this service may still be continued. The following program has been inaugurated and will be in force Wednesday and Saturday nights until further notice:

7.30-7.32—General call to all stations, call Q. S. T. signed Pitt; 7.32-7.50—Athletic results; 7.50-8—Items of interest to the public (12 words per minute); 8-8.10—News items at speed of 20 words per minute; 8.10-8.30—Special tests.

Scientific Class Organized in West Hoboken, N. J.

A Scientific Class has been organized in School No. 4, West Hoboken, N. J. Anthony Marino is president. The staff of research workers are John Saldavini, George Matterichi and John Reinert. We would be very pleased to correspond with similar organizations. All mail should be addressed to Anthony Marino, 511 Traphagan St., West Hoboken, N. J.

MEETING OF Y. M. C. A. RADIO CLUB OF VINCENNES, IND.

The Y. M. C. A. Radio Club of Vincennes held its first meeting at the Y. M. C. A., Tuesday, Nov. 30, and was well attended. The club has a very able instructor, who has worked as an operator on the Great Lakes. The following officers were elected: Walter A. Horner, first operator and president; John W. Surbaugh, second operator and secretary; Clinton E. Simpson, third operator and treasurer.

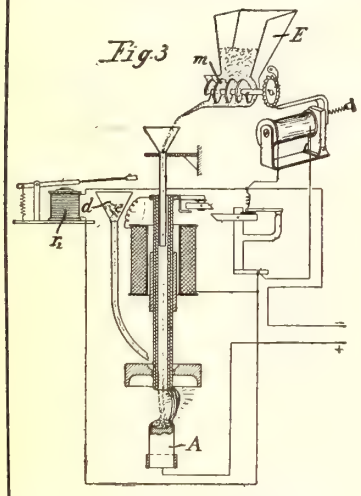
All radio correspondence from radio organizations and interested individuals should be addressed to the secretary, 912 Broadway. Those wishing to confer with the president will find him at 1225 North Second street.

LATEST PATENTS

Novel Electric Arc Lamp.

(No. 1,159,383; issued to Richard Holsten, assignor to Siemens-Schuckertwerke G. M. B. H.)

Electrical arc lamp employing for the lower electrode a suitable cup-shaped chamber A, into which a continuous and properly regulated stream of fine particles such as pure carbon (or any desired mixture of carbon with other substances which emit a strong light, such as metallic salts and the like), are fed. The arrangement is apparent from the illustration. The changing length

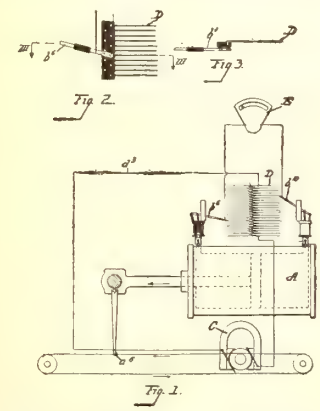


of the arc controls a magnetic clutch which feeds the pulverized carbon from a hopper E through the medium of a worm M. The metal salts may be injected separately through a hopper D, controlled by the magnet R^2. A very interesting patent.

Electrical Horsepower Indicator for Engines.

(No. 1,159,769; issued to Walter H. Hollstein.)

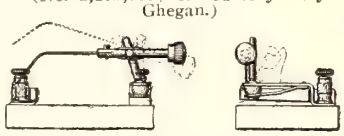
An electrical form of steam engine indicator for ascertaining the horsepower developed is covered in this patent. It appears to be quite feasible and a distinct advantage in this line. As perceived from the illus-



tration the piston rod or cross-head a^2 controls a belt secured to it and also to the shaft of a small dynamo C. The current from this dynamo passes through a resistance D. The changing steam pressures in the cylinder A, actuates the spring controlled rheostat arms b^6 and b^{10} by means of pistons. These rheostat arms slide over contact points as shown in Fig. 2, which lead to the different turns in the resistance coil D. The indications are given on a curve drawing, electric voltmeter E, which may be specially calibrated to indicate results in "horsepower" direct.

Holder for Crystal Detectors.

(No. 1,162,765; issued to John J. Ghegan.)

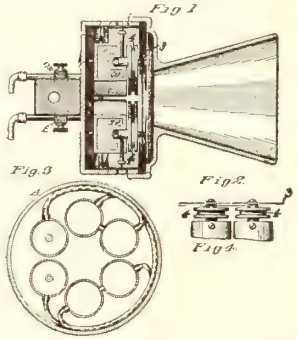


An improvement in wireless mineral detectors giving great ease of adjustment by virtue of the ball joint support of the vertical pillar, carrying the cat-whisker contact. The horizontal arm is also pivoted so as to be adjustable to any position desired. The contact wire can thus be swung up, down, or sidewise, also forward and backward.

Heavy Current Microphone.

(No. 1,165,255; issued to Charles D. Herrold and Emile A. B. Portal.)

A clever design of water cooled, heavy current microphone is here depicted. This patent covers the arrangement for utilizing a multitude of water cooled chambers on the end of each of which there is mounted the usual microphone chamber with carbon grains, etc., 4. These microphone units are all secured to a common metal diaphragm 3. The various water cooling chambers are so piped that water enters into the first one of the group and

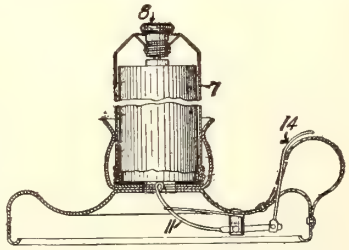


then passes consecutively throughout the entire number before it leaves the transmitter. The design should prove efficient if the size of the diaphragm 3 can be kept down within normal limits.

Portable Electric Lamp.

(No. 1,166,003; issued to Adolph C. Recker, assignor to Waterbury Mfg. Co.)

This patent relates to portable electric lamps, particularly of the candlestick variety. Flashlight battery of the ordinary type fits within a shell or chamber 7. The flashlight bulb is seen at 8, and the circuit from the battery is completed through a switch 11. This switch

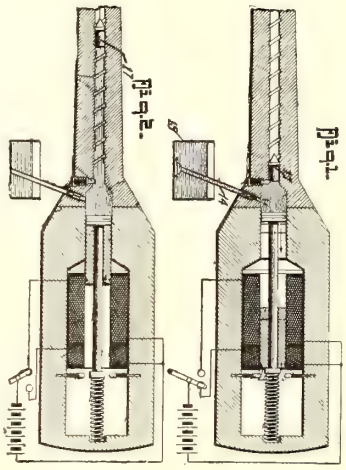


blade is pushed against the end of the battery by a convenient thumb-actuated pin, pivoted in the manner shown. The best feature is that of the control switch.

Electro-Hydraulic Gun.

(No. 1,167,178; issued to Rollie Calvin Hill.)

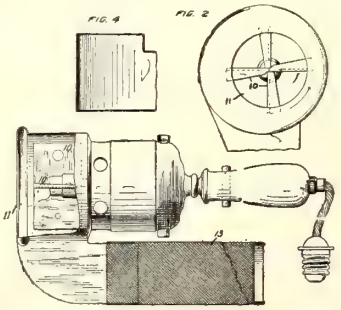
This patent covers the use of water or other fluids in combination with an electro-magnetic propelling mechanism for the ejection of projectiles from a cannon. The patent describes a double solenoid arrangement whereby a switch can be thrown so as to push or pull an iron plunger within the solenoid. When pulled backward, it sucks in the liquid from a tank 15 and when the solenoid is switched to the firing position, the plunger is rapidly propelled forward, simultaneously closing a check valve in the suction pipe 14, and ejecting the projectile 17, by virtue of the sudden rise in the hydrostatic pressure thus obtained.



An Electric Fly-Catcher.

(No. 1,165,712; issued to Frank Rea, assignor of one-half to Arthur M. Sheakley.)

Another electric fly-catcher is here shown which involves the use of a small fan of special design. The metal chamber about the fan is of peculiar shape and terminates in a metal wire cage 13. The apparatus may be plugged into any lamp socket and consumes but little current. In service the flies or other

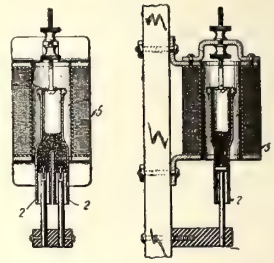


insects are drawn in through the opening 11. The fan blade appears at 10.

Coherer and De-Coherer.

(No. 1,167,163; issued to Crosby Field Frank, assignor to General Electric Co.)

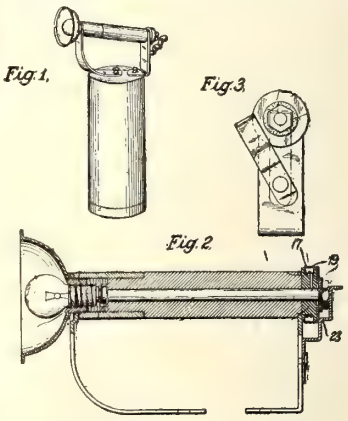
A reliable form of the filings type coherer suitable for transmission line signaling or for other purposes. The patentee mentions the use of granules of nickel specially prepared. The de-cohering is done by means of a magnet coil shown and by the special construction of the coherer tube. The granules when lifted by the magnet coil 5, will be dropped again unevenly, thus conducing to the regular and reliable resetting of the device. A constant and sharp critical voltage value can be obtained with this improved coherer it is claimed.



Electric Hand Lantern.

(No. 1,163,887; issued to Charles F. Burgess, assignor to C. F. Burgess Laboratories.)

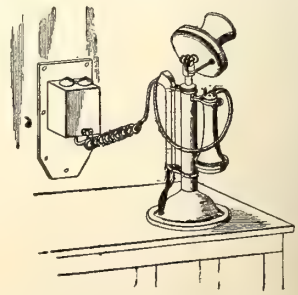
An ingenious electric lantern attachment suitable for use with standard dry cells is here shown. The inventor provides a small rheostat in the end of the handle at 17, to protect the lamp when first used on a fresh cell. 23 is then thrown in contact with the shell 19, leaving the resistance in series with the lamp. As the battery begins to lose its energy, the switch is pushed into a vertical position and the lamp burns direct. This attachment can be adapted for use on two dry cells with a strap around them.



Telephone Cord Guard.

(No. 1,164,563; issued to Oadville Yates, Sr.)

The inventor of this attachment for taking up slack telephone cord to avoid abrasions, provides for the purpose a spiral wire spring with small hooks on each loop of the spiral. The telephone cord is wound around this spiral on the inside of it. When the 'phone is unmoved, the spiral appears as in the illustration, but when the 'phone is



moved, it expands. A guard is also indicated for protecting the cord.

COPIES OF ANY OF THE ABOVE PATENTS SUPPLIED AT 10c. EACH.

Phoney Patents

Under this heading are published electrical or mechanical ideas which our clever inventors, for reasons best known to themselves, have as yet not patented. We furthermore call attention to our celebrated Phoney Patent Offizz for the relief of all suffering daffy inventors in this country as well as for the entire universe.

We are revolutionizing the Patent business and OFFER YOU THREE DOLLARS ($3.00) FOR THE BEST PATENT. If you take your Phoney Patent to Washington, they charge you $20.00 for the initial fee and then you haven't a smell of the Patent yet. After they have allowed the Patent, you must pay another $20.00 as a final fee. That's $40.00 ! ! WE PAY YOU $3.00 and grant you a Phoney Patent in the bargain, so you save $43.00 ! ! When sending in your Phoney Patent application, be sure that it is as daffy as a lovesick bat. The daffier, the better. Simple sketches and a short description will help our staff of Phoney Patent examiners to issue a Phoney Patent on your invention in a jiffy.

PHONEY PATENT OFFIZZ

No. 40° 15' 7" N E by E. **Patent Applicated Feb. 30, 1916.**

THE ELEGGTRICAL EGG EGGSTRACTOR

Be it a secret to all:

That I, Egg S. Natcher, of Yolkville, in the State of Remorse, have devised certain improvements worthy of notice by egg swipers who desire to eggstract the eggs from a nest without eggciting the eggmakers.

The attached specifications and drawing expose all the inards of the machination and lay bare the devilish details of my method of coercing the feathered bipeds to deliver up their contraband goods without the necessity of declaring a blockade.

Considering the details of this nightmare, at 1 is shown an ediffice known as a hen house, named after the inhabitants who abide or reside therein. The chicken on becoming ambitious mounts corrugated pathway 2 leading to the nest. The weight of her wait on the board compresses bellows 3 and thus pumps air into tank 4 and is there stored. The hen then passes into the boudoir 5, at which point, dear reader, we gently draw the curtain.

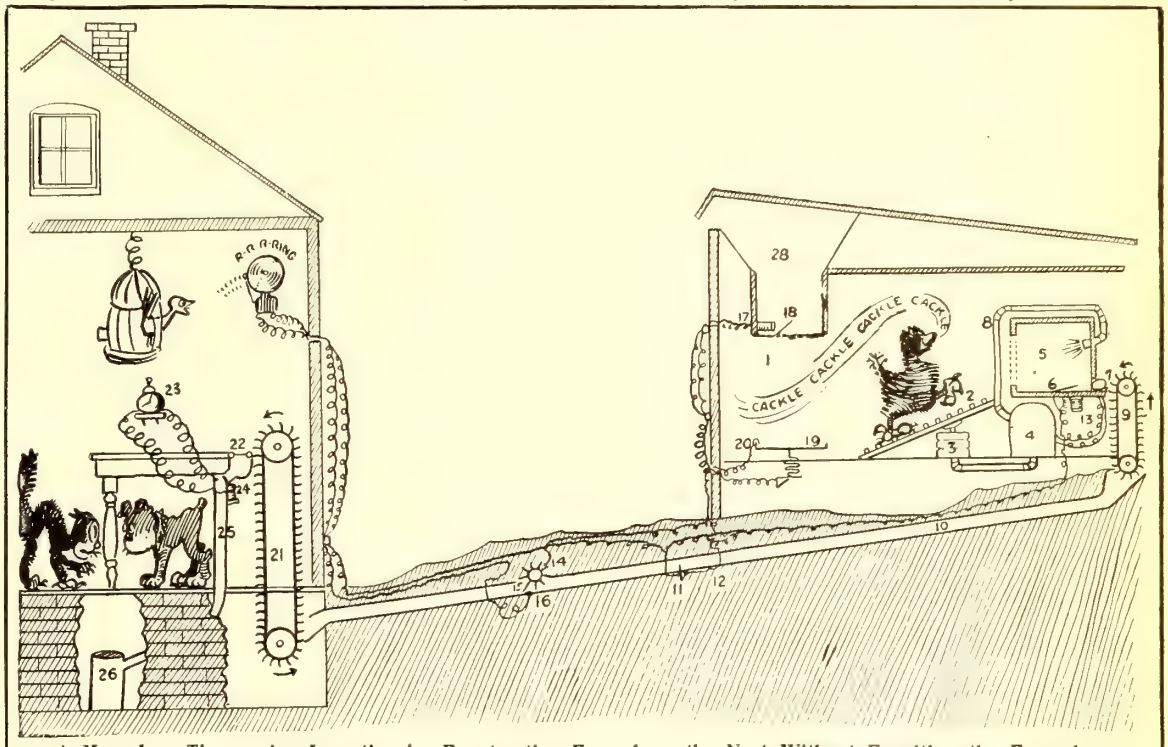
A few minutes and the click of the switch 6 is heard as it is pushed onto contact 7 by the egg. The closing of the switch releases a stream of compressed air from tank 4, which flows through pipe 8 and gently but firmly makes it evident to the hen that her presence is no longer required.

The lonesome and unloved egg rolls then onto conveyor 9 and thence through underground tube 10. With a rising and falling, sinuous motion it approaches switch 11 and without warning swings it onto contact 12 and then continues its explorations. The switch 11 cuts off compressed air supply and resets switch 6 by means of electro-magnet 13 and also rings bell in house to warn the reception committee of the approach of their guest of honor.

The egg, then, egglike rolls against the wheel 14 and turns it one notch. On the wheel is arranged a projection that as the wheel completes a revolution makes contact with 16. Instantly electro-magnet 17 acts, opens door 18, allows feed to flow from hopper 28 into pan 19 which, on becoming full, settles gently down on the spring, opens contact 20 and thus hopper door is closed by its own weight.

But to follow the egg. It is rolling along, then suddenly lands on conveyor 21 and gets a raise up, up and over into receiver 22. It rests here awhile from its labors but is quickly awakened by the alarm clock, which closes a circuit, energizes magnet 24, and drops it down through tube 25 into the tomb 26, wherein it is stored. The alarm advises the house of the arrival of the newly born.

In testimony hereto, thereof, I attach my handcuff and seal-packerchief this yesterday of to-morrow in the City of Yolkville.



A Marvelous Time-saving Invention for Eggstracting Eggs from the Nest Without Eggciting the Eggmakers.

(Signed) Egg S. Natcher,
By his attorney,
Geo. M. Gray,
Needham, Mass.

Witnesses: Sol. Idivory, Hen Nery, R. O. Oster.

THE "ARLINGTON" BUG?

This is an introduction to one of Dame Nature's curiosities and mysteries! X— ??

The other night I was awakened by a shrill —. .— .—, and thought I must have dreamt it; but I heard it twice before going to sleep. The next morning we found a large green winged insect which I suspected of working its "transmitter" on Arlington's call. (N. A. A.)

I would not believe this story myself, if someone else told it, but would like to know if anyone else among the *Electrical Experimenter's* readers has had the same experience.

(*If the "green" bug had an "antenna" it probably was tuned to the tune of "N. A. A.," which caused it to sing when Arlington was sending, what?—Ed.*)

Contributed by

PAUL F. SHNEY.

HEARD OVER THE TELEPHONE?

Pat was called into court to testify to a talk that he had had with the defendant in a civil suit, and everything went along as swimmingly as a flock of bullfrogs until the lawyer attempted to bring out the important points of the conversation.

"Now, then, Pat," said he, encouragingly, "please tell the court what you and the defendant talked about."

"Yis sor," answered Pat, willingly. "We talked about 15 minutes."

"No, no, no!" interposed the lawyer. "I mean what did you and the defendant talk over?"

"Yis, sor," was the calm rejoinder of Pat. "We talked over the tilephone, sor."

THE TUNELESS SOLO.

Signor Marconi, the wireless inventor is likely to prove of great value to his country in the present crisis.

An amusing story is told about a reply that the celebrated inventor once made to a lady who mistook him for his equally famous compatriot, Mascagni, the composer.

"Oh," she said, gushingly, "I'd love to hear you play your beautiful 'Intermezzo!'"

"Madam," replied Marconi gravely, "I'll do it with pleasure if you've got a wireless piano."

QUESTION BOX

This department is for the sole benefit of the electrical experimenter. Questions will be answered here for the benefit of all, but only matter of sufficient interest will be published. Rules under which questions will be answered:

1. Only three questions can be submitted to be answered.
2. Only one side of sheet to be written on; matter must be typewritten or else written in ink, no penciled matter considered.
3. Sketches, diagrams, etc., must be on separate sheets. Questions addressed to this department cannot be answered by mail.

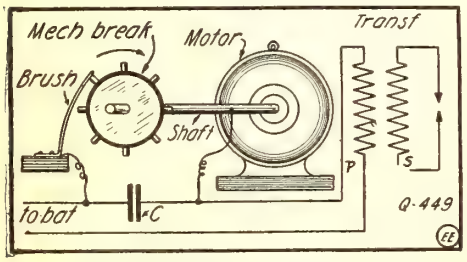
WATCH DEMAGNETIZER.

(448.) William H. Kelly, Holyoke, Mass., wants to know the number of feet of copper wire required to build a 110-volt a.c. watch demagnetizer.

A. About 1,000 feet of No. 30 B. & S. gauge copper wire would be necessary. This should be wound on a brass form or bobbin, having an opening large enough to admit a watch. The length of the spool should be about two inches.

TRANSFORMER.

(449.) C. L. Bauman, Cherokee, Ia., asks whether he can employ a 16-cell battery plant of 32 volts and 120 ampere hour capacity to operate his flexible step-up transformer.



Mechanical Break for Spark Coils.

A. The transformer can be successfully operated from this plant by employing a suitable interrupter. This interrupter may be of the independent magnetic or mechanical break type. The accompanying illustration gives the connections for the interrupter and transformer.

LOUD SPEAKING RECEIVER.

(450.) Buran Studdard, Leavenworth, Kan., asks us several questions which he would like to have answered. 1. The cost of a telegraphone, as described in the June, 1915, issue of *The Electrical Experimenter*. 2. The price of a loud speaking telephone receiver.

A. 1. The cost of the experimental telegraphone would be in the neighborhood of $75, although this amount would be reduced if built by yourself.

A. 2. A loud speaking telephone receiver would cost $25 of the type to be used in place of an ordinary 75 ohm receiver. A plain independent type loud speaker complete with microphone and rheostat for battery circuits costs about $5.

AUDION BULBS.

(451.) Edward Law, Clarksburg, W. Va., wants to know: 1. Whether a 6-volt 40-ampere hour storage battery will operate an audion as well as six dry cells. 2. The average life of the tantalum filament of the audion bulb. 3. The length of time such a storage battery will last, if used but two hours per day in connection with the audion.

A. 1. The 40-ampere storage battery will successfully operate the audion bulb and, in any case, it will be more satisfactory than the dry cells for this work.

A. 2. The average life of the tantalum filament in the audion is about 400 hours, but this can be lengthened by using the filament at a lower incandescence, i.e., by using a rheostat.

A. 3. Your storage battery will operate the audion bulb for about 40 days if used but two hours each day, without recharging.

WIRELESS BOOKS.

(452.) Fred W. Jameson, Leavenworth, Kan., asks for information on the following: 1. The title of a book on the construction of high grade wireless apparatus. 2. Whether the primary of a loose coupler should be wound with stranded wire, and if the loading coil used in connection with the coupler should be wound with the same size wire. 3. The location of an antenna in regard to a high voltage transmission line.

A. 1. We can recommend two excellent books covering this subject, which are published by The Experimenter Publishing Co. They are "How to Make Wireless Sending Apparatus" and "How to Make Wireless Receiving Apparatus," which are sent prepaid for 25 cents each.

A. 2. The primary of a high grade loose coupler should be wound with stranded wire. While the loading coil may be wound with the same size wire as the loose coupler, it is better to use a larger size wire for this instrument.

A. 3. It would be all right to place a 200-foot aerial directly over and at right angles to the 2,300-volt line. It is also advisable to use means to prevent accidents resultant from having the antenna fall on the transmission line, which would be dangerous in the extreme.

WAVE LENGTH OF COUPLER.

(453.) Leonard Mabbott, Aberdeen, S. D., wishes to know: 1. The wave length of his loose coupler. 2. The reason he can hear a certain station with one hook-up and not with another. 3. The positions of the slider of a loose coupler when it is at its lowest and highest capacity, respectively.

A. 1. The maximum wave length that can be obtained from the loose coupler you describe is 1,800 meters.

A. 2. The reason for your not being able to hear the amateur station you mention with the loose coupler circuit is that the wave length is longer than the transmitting wave from the other station, but this can be remedied by connecting a variable condenser in series with the ground.

A. 3. When the sliders are at the starting end of the winding of a loose coupler, the instrument is being used at its minimum capacity; conversely, when they are at the opposite end of the winding the maximum wave length capacity is reached.

ANTENNA QUERIES.

(454.) George D. Hankins, Yorktown, Ind., 1. Sends us a diagram of his antenna, and wishes to know whether a better type could be designed with the same amount of wire. 2. The efficiency of the loose coupler described in the September, 1915, issue of *The Electrical Experimenter*.

A. 1. A straight four-wire antenna would be more efficient for transmitting than any other form of aerial, but the same amount of wire used in a single line would make a far more efficient antenna for your receiving purposes than most other types.

A. 2. Although this loose coupler with both windings wound with No. 26 wire would be almost as efficient as if wound with No. 24 and No. 28 wire respectively, yet it is advisable to have the windings of different sizes of wire. This depends upon the type of detector employed, i.e., whether potential or current actuated.

PROBLEMS IN ELECTRICAL WORK.

(454A.) Jas. A. Davis, Pittsburgh, Pa., sends us several electrical problems: 1. How many amperes will a 22 h.p. dynamo produce, the output of which is 120 volts? What is the resistance? 2. A relay has four windings of 10, 20, 25 and 80 ohms connected in parallel. What is the resistance of the relay? 3. If .08 amperes flows through a keyboard lamp, what is the difference of potential?

A. 1. This dynamo will produce 136.7 amperes. The resistance is .087 ohms. These results were obtained by multiplying the 22 h.p. by 746 watts and dividing the product by 120 volts, which gives the amperes. The resistance is obtained by substituting the values in the following formula:

$$R = \frac{E}{I}$$

R in ohms, E in volts and I the current in amperes.

A. 2. The answer to this problem is 4.9 ohms. This result was obtained by substituting the values given in this formula:

$$R = \frac{1}{\frac{1}{r} + \frac{1}{r_1} + \frac{1}{r_2} + \frac{1}{r_3}};$$

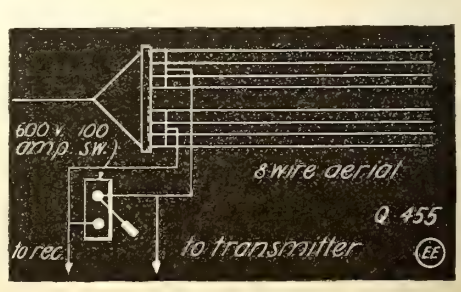
where r and r_1, etc., stand for the given resistance values.

A. 3. We cannot say what the difference of potential is as you do not state the resistance of the circuit. It is necessary in order to obtain the difference of potential of any circuit to give both the current and resistance.

PUMP USED FOR GROUND.

(455.) Experimenter, Jackson, Mich., wishes to know: 1. Whether a pump could be used for a ground. 2. A diagram for an eight-wire aerial constructed in such a

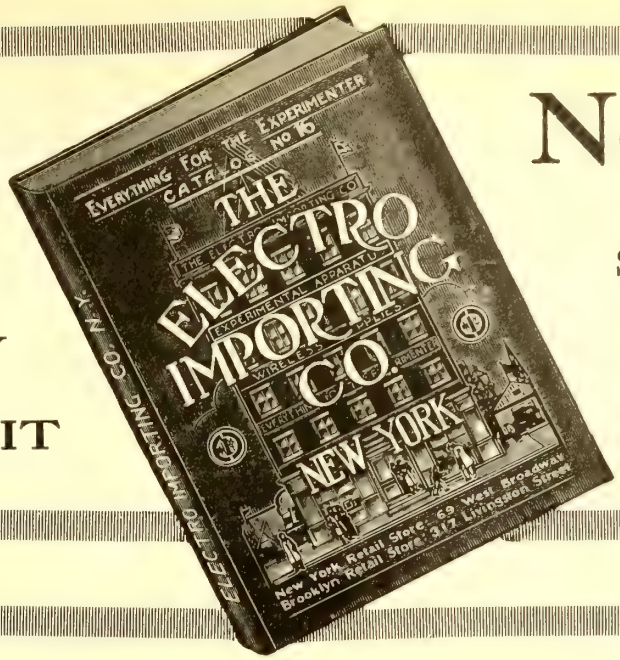
(*Continued on page* 650.)



Hook-up for Eight-Wire Aerial, with Change-Over Switch.

CAT. No. 16

SEND FOR IT TO-DAY YOU NEED IT



Sent FREE for 4c to cover postage only

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It contains the largest assortment of Wireless and electrical experimental apparatus shown in any catalog published. In addition are shown Commercial Wireless Sending and Receiving Outfits, Electric Motors, Dynamos, Flashlights, Medical Batteries, High Frequency Apparatus, Plating Outfits, Toys, Printing Presses, Tools, Sporting Goods and the LARGEST Scientific Book section published. This book will give you as much information as many books that cost you $1.00 or more. SEND FOR THIS WONDERFUL BOOK TO-DAY, WHICH IS FREE. YOU TO PAY 4c. FOR POSTAGE ONLY.

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It contains 658 illustrations, 2,000 articles, complete Code Chart of Morse, Continental and Navy Codes, sixteen-page "TREATISE ON WIRELESS TELEGRAPHY," list of Call Letters of U. S. Government and Commercial Ship and Shore Wireless Stations, besides a great many useful tables, and formulas. This valuable book is 6¾ x 5¼ inches in size and ½ inch thick, and well bound. IT IS SENT FREE FOR 4c. TO COVER POSTAGE ONLY.

Watch for Our New Catalogue

Electro-Set News

Published by The Electro-Set Co., Cleveland, O.

Watch for Our New Catalogue

MARCH, 1916. 1874 EAST SIXTH STREET

Audion "B" Batteries—50 Volts!!

FOR THE NEW MODEL AUDION DETECTORS

THE ELECTRO-SET COMPANY announce the development of a new, high potential battery for Audion Detectors.

These batteries have been developed for us in the most complete laboratory of its kind in the world.

They are especially designed for long shelf life and voltage maintenance and are a long step forward over the old makeshift flashlight batteries formerly used for the purpose.

Electro-Set Audion "B" batteries will not only increase the efficiency of these splendid wave detectors, but will also prove a considerable saving over the old type, both in initial cost and maintenance.



The open circuit potential of these batteries is about 50 volts; one Electro-Set Audion "B" battery replacing 12 flashlight batteries.

The new model Audion Detectors have been reduced in price and are no longer furnished with batteries of any description.

Our new "B" batteries will, therefore, be a welcome product to the trade.

They are recommended over any other form of battery for the purpose

Price, each, 50 volts tested and guaranteed.....**$3.50**

Shipping weight 8 lbs.

NOTE: Electro-Set Audion "B" batteries are designed only for Audion use. They are not to be used for any other continuous duty.

Why Buy Minerals on a Gamble?

The least expensive and the *most important* part of your wireless equipment is the mineral in your detector.

An expensive receiving equipment will do only mediocre work if the detector is not sensitive. *Don't Neglect This Important Point.*

READ WHAT OTHERS SAY!

A few letters selected at random from our files.

Milan, Ohio.

The Arlington Tested Galena Crystal that I bought of you some time ago has given the best service, by far, of any crystal I have yet used.

Yours very truly, RALPH H. SAYLES, Jr.

N. Manchester, Ind.

I received your N A A Tested Galena. It is more satisfactory than advertised. Yours truly, EUGENE SMITH.

Purcell, Okla.

I received the N A A Minerals last week, and I want to tell you that better results have been obtained with them than with any other.

Yours truly, JACK GILLETTE.

It costs mighty little to get extremely sensitive minerals. But it requires caution. Look carefully where you buy. To be *sure* accept only *Electro-Set Wireless Minerals*. Every package marked thus

GENUINE ELECTRO-SET MINERAL

Look for the Signature

J. S. Newman PRES.

THE PRICES ARE HIGHER.

They have to be. Our buyers scour the world for these supremely good minerals—but remember, after all, that even Electro-Set Minerals are not too high priced for the smallest pocketbooks.

ARLINGTON TESTED MINERALS
INDIVIDUALLY PACKED AND TESTED.

N A A Galena, each crystal carefully tested by experts for distant stations. Individually wrapped and packed in wood containers. Postage paid.....25c.

N A A Silicon, individually tested, wrapped and packed. Postage paid.....25c.

N A A Zincite Couple, specially selected, tested and packed. Extremely sensitive. Postage paid.....50c.

ELECTRO-SET ARLINGTON SILICON

Triple "A" Grade Electro-Set Minerals
Packed in convenient one, four and sixteen ounce cartons.

These ultra-sensitive minerals are the only ones you should buy. Look for the original signature on the wrapper.

PRICE LIST OF TRIPLE "A" GRADE MINERALS

	1-oz Can	4-oz Can	16-oz Can
Galena	25c.	60c.	$1.50
Silicon	25c.	75c.	2.50
Bornite	25c.	75c.	2.50
Copper Pyrites	25c.	60c.	1.50
Iron Pyrites	25c.	50c.	1.50
Molybdenite	25c.	70c.	2.00
Carborundum	25c.	60c.	1.50

Zincite, Pure, per ¼ oz. Can, 50c. **Prices are prepaid**

Dry Storage Cells



CAN BE RECHARGED 300 TIMES.

One charge has energy of **seven** dry cells. 400 amperes on short circuit.

These cells are the newest development in the storage battery field.

They may be used in any position, are easy to transport, cannot spill or corrode, and are ideal for experimental work of any description.

Each cell develops two volts in full charge and has a capacity of 20 ampere hours. They are convenient in shape being about of the same dimensions and size as an ordinary dry battery.

The price is so low that any experimenter can afford them. In the long run, they are much less expensive than dry cells and any garage will charge them at very low cost.

If you have 110 volt direct house current, these batteries may be charged by **merely connecting them in series with 1-100 watt lamp** or 4-25 watt lamps in multiple

USES:

Audion detectors (filament batteries).
Portable and Stationary Wireless Sets.
Automobile Lighting.
Experimental Work.
Hand Lanterns.
Stationary Engine Ignition.

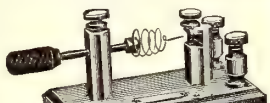
In fact, these batteries may be used in place of any other type of storage cell.

Allow 1 cell for every 2 volts required (i.e., for 6 volts use 3 cells, etc.) Shipping weight 5 lbs.

Price, each.....**$2.00**

SEND FOR CIRCULAR.

The Mineral Detector



We have greatly improved our popular No. 1603 Detector with no increase in price.

This type mineral detector is the most convenient and easily adjusted ever produced.

In connection with our famous super sensitive minerals, it is as sensitive a detector as you could desire.

Handsome in appearance and generous in size.

The cat whisker wire is easily removed, and replaced in the **Special Chuck Holder.**

Minerals are readily inserted and are firmly held in good contact. Any degree of pressure may be brought to bear on the mineral.

Price, postage paid.....**$1.25**

Dept. 510 *The* **Electro-set Co.** **1874 E. 6th St. Cleveland, O.**

SEND 4c. IN STAMPS FOR CATALOGUE

QUESTION BOX.

(*Continued from page* 648.)

manner that four wires may be used for transmitting and the whole number for receiving.

A. 1. The pump can be successfully employed for a ground.

A. 2. The diagram herewith shown gives the constructional details of an eight-wire aerial to be used in the manner you specify.

ANTENNA EFFECTS.

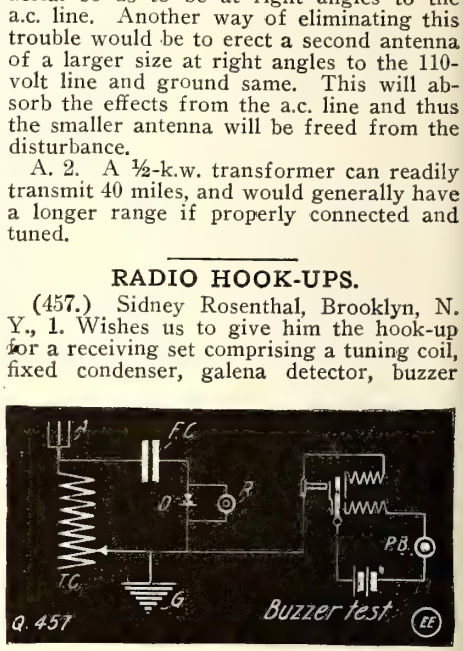
(456.) John Bedford, Morsemere, N. J., desires to know: 1. Whether a 110-volt a.c. line would affect the reception of messages through an antenna placed four feet distant. 2. Whether a ½ k.w. transformer would transmit 40 miles.

A. 1. The 110-volt a.c. line would affect your receiving antenna if they are parallel to each other. You could eliminate this trouble by changing the position of your aerial so as to be at right angles to the a.c. line. Another way of eliminating this trouble would be to erect a second antenna of a larger size at right angles to the 110-volt line and ground same. This will absorb the effects from the a.c. line and thus the smaller antenna will be freed from the disturbance.

A. 2. A ½-k.w. transformer can readily transmit 40 miles, and would generally have a longer range if properly connected and tuned.

RADIO HOOK-UPS.

(457.) Sidney Rosenthal, Brooklyn, N. Y., 1. Wishes us to give him the hook-up for a receiving set comprising a tuning coil, fixed condenser, galena detector, buzzer



Simple Wireless Receptor-Circuit With Tuning Coil.

test and receivers. 2. Also if two persons can operate separate receiving sets from the same aerial.

A. 1 The illustration herewith shows the connections for the instruments you mention.

A. 2. It is possible for two receiving sets to be operated from the same aerial, but the energy received in either one set would be considerably reduced, unless the wave lengths utilized are quite different in value.

ROTARY GAP.

(458.) Rudolph Wensko, Cleveland, O., inquires: 1. Whether a rotary gap will work on a ½-k.w. transformer coil. 2. At what speed must an amateur be able to send and receive signals in order to obtain an amateur license. 3. The manner in which the taps of a Navy loose coupler are connected, so that one turn at a time may be obtained.

A. 1. A rotary gap can be successfully operated on a ½-k.w. transformer coil, but a quenched gap is best.

A. 2. An amateur must be able to receive and send at least 10 words per minute to obtain a government radio license. He must also be familiar with the technical

details of radio apparatus to a fair extent.

A. 3. A description of the Navy type loose coupler was published in the September, 1915, issue of *The Electrical Experimenter*, which included the method of connecting the taps so as to obtain single turns at a time.

RADIO TELEPHONE.

(459.) Edward C. Jones, Jr., Fairmont, W. Va., wishes information as to: 1. Whether there is an inexpensive wireless telephone set available that can transmit three miles. 2. If it is possible to construct a wireless telephone with a 1-inch spark coil, microphone, etc., and obtain good results. 3. Whether a dictaphone, of the type described in a recent issue of *The Electrical Experimenter* could be used as an amplifier.

A. 1. As far as we know there is no cheap wireless telephone for the use of the amateur on the market, but we would suggest that by writing the Radio Telephone and Telegraph Company, of New York City, you would no doubt be able to find out if any such telephone is for sale at a price within your reach.

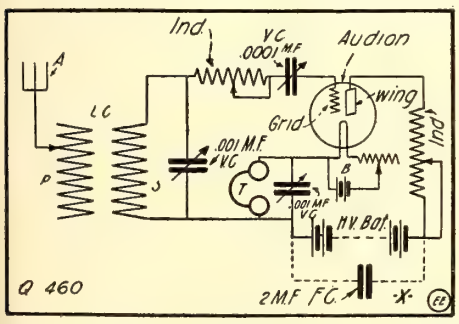
A. 2. It is possible to construct a simple wireless telephone outfit by employing a 1-inch spark coil, microphone, etc., but the results would be very poor on account of the unequal sparking rate of the gap which gives irregular sounds at the receiving end, and also due to the low frequency of the sparks. Although the results may be bettered by using several spark coils connected in parallel so as to form a multiple sparking gap, which will increase the sparking rate of the complete device of course. Even then the speech at the receiving end will not be clear. This outfit will transmit over a short distance of, say, about a mile or more. A very short spark gap must be used, about the thickness of the paper of this page.

DIAGRAM FOR UNDAMPED WAVE RECEIVER.

(460.) Reginald Pink, Bronx, N. Y., wishes us to give him the following information: 1. A diagram of an undamped wave receiver employing the audion. 2. The size of wire employed in winding the various coils. 3. Whether the Electro Importing Co.'s Mignon Vario-Selective coupler will receive undamped waves with an audion.

A. 1. The accompanying illustration gives the proper hook-up for the reception of undamped waves, employing the audion. The capacities of the various condensers are given. Condenser X is optional but is strongly recommended.

A. 2. The secondary loading coil is wound with No. 28 B. & S. copper magnet



Audion Circuit for Reception of Undamped Waves.

wire on a tube 4 inches diameter, 30 inches long; while the winding of the "wing" coil is of No. 30 B. & S. copper magnet wire wound on a similar size tube.

A. 3. The coupler you mention may be successfully employed for the reception of

Multi-Audi-Fone

The new wonder in the wireless world. It increases the Audibility 1,500 Times

We Guarantee Everything We Make! We Guarantee Everything We Say!

Every County Attorney should have one of our **Detectorphones** if he wants to know what offenders are plotting.

EveryHotel should have some rooms equipped with our **Detectorphones** in order that they may detect and eject objectionable characters.



Every Business Man should have one of our **Detectorphones** if he wants to know which of his employees is planning and plotting to bring on a strike.

Every Detective should have one of our **Detectorphones** if he wants to succeed, for you can tell just what the fellow you are after is saying even in the faintest whisper, forty feet away, in the garret or in the cellar.

Price, $35.00.

UN-DAMPED-WAVER.

Do you want to get Nauen, Hanover, Sayville, Tuckerton, San Francisco, Honolulu and the Naval Arc Stations on just a good, ordinary Aerial? Do you want to become thoroughly familiar with the action of the new valve circuits? Then you want our Un-Damped-Waver.

Price, $100.00.

TWO STEP MULTI-AUDI-FONE.

Are you a jeweler? Do you want Arlington time shouted to your visitors every day at 12? Are you a teacher of wireless? Do you want your 500 students to read the signals? Both of you men should have our Two Step Multi-Audi-Fone with its Trumpet Horn with specially wound Head Set.

Price, $75.00.

MULTI-AUDI-FONE.

Do you want to get a lot of stations you do not hear now? Do you want to get those you now hear only faintly and unsatisfactorily, clear and strong, often even audibly? Do you want to enter a new Wireless World? Then you want our Multi-Audi-Fone.

Price, $30.00.

TELEPHONE VOICE MULTIPLIER.

Are you hard of hearing? Are your Telephone lines or connections poor? Are your long-distance calls weak? Do you want to know exactly what the fellow at the other end of the line is saying? Then you want our Telephone Voice Multiplier.

Price, $15.00.

Everyone of these instruments is *one hundred fold better than any other instrument of its kind.*

If you don't believe it—try them.

If after a ten days' trial you are not surprised and more than satisfied—we will return your money.

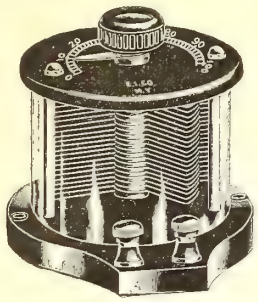
Will any one else do this? **Tear this out and ask for information about the instrument that interests you by writing its name here**

Send for circular to-day
Ask your dealer to-morrow

MULTI-AUDI-FONE 273 Morris Ave. ELIZABETH, N. J.

Chicago Wireless Headquarters

CLOSING OUT LARGE LINE OF RAW MATERIALS, PARTS, Etc.



ROTARY VARIABLE CONDENSERS

Only transparent rotary variable condenser made that can be screwed down, filled with oil to increase capacity and has binding posts on bottom where they belong. The 43 plate condenser has a capacity of .001 m.f. The 17 plate has a capacity of .0003 m.f.

No. 9240—17 Plate Rotary Variable Condenser, $2.25
No. 9241—43 " " " " 3.75



No. 10. TUNGSTEN FLASHLIGHT
6 inches long, complete .....**65c.**
Extra battery....**20c.** Extra bulb....**15c.**

60 and 100 Watt Nitrogen Lamps use less current; give white light.
60 Watt.....**85c.** 100 Watt.....**90c.**



No. 125. TUNGSTEN NICKEL VEST POCKET FLASHLIGHTS with Tungsten bulb and Ever-Ready Battery, complete.....**45c.**
Extra bulb, **15c.** Extra battery, **20c.**

FINE **50c.** POCKET CIGAR LIGHTER. Turn the wheel. Flint good for 5,000 lights. (2 for **25c.**), or each **15c.** New Flints, **5c.** 6 for **25c.**

We carry a very complete line of Wireless Apparatus in stock, being Chicago headquarters for the Electro Importing Co. Same prices, same goods and Free Wireless Course. Lionel Trains, Motors, Transformers, Wireless Outfits, Structo Metal Building Material, Automobile and Electrical Supplies. Send 4c. in stamps for complete catalogs.

LA SALLE LIGHT COMPANY, 134-136 N. La Salle St., Chicago, Ill., Opposite City Hall

NEW WIRELESS WONDER

THE INSTANT RADIOGRAPH

Greatest invention of the Age. The result of years of experimentation.

Abolishes detector troubles and adjustments—
No more delays—no more lost time and messages

Pick up your receivers any time, Summer or Winter, in any atmospheric conditions and—

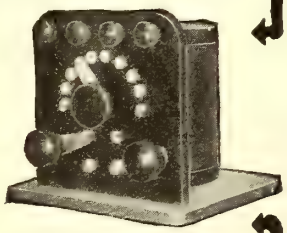
You Can Receive Instantly Without Any Adjusting

3,000 miles is latest record of the Instant Radiograph.

It is wonderful, but true, you cannot get the Instant Radiograph out of adjustment no matter how you knock it about. Try it yourself, hit it with a hammer while in use.

Vibrations, jars, knocks cannot affect it as there are no fine adjustments to make—no batteries—nothing to wear out—no operating expense whatever.

INTRODUCTORY PRICE FOR MARCH **$3.00**



Cut ¼ Actual Size.

The Instant Radiograph is more efficient than any detector on the market, as there is nothing to adjust.

The Instant Radiograph is beautifully and solidly constructed on a heavy base of hard rubber 4 x 4 inches square with rounded corners and 4¼ inches high; binding posts are made of non-corroding metal, heavily silver plated, and have heavy rubber-covered thumb screws, preventing current leakage. **All contacts are large, non-corroding, heavily silver plated, of large size and will last a lifetime. This is a wonderful instrument of distinctive appearance that you will be proud to have in your wireless station.**

The Radiograph is the greatest recent invention in the Wireless field. Its value is priceless and as we want every professional and amateur operator on land and on board ships to use it, we have decided to make an introductory price of $3.00 for a limited time only. This is only one-third of the price at which it should be sold. Send your order at once. **Send for free Catalog E of the Instant Radiograph.**

You need this new book. "Radio Stations of the World." A complete authentic list of call signals of every public wireless station. Price, only 50c.

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This New Tuner Only $8.00

"Your New Receiving Transformer having 20 taps on the primary and 9 on the secondary is very efficient, and worth twice as much as the one with sliders, although that tuner does great work. Gordon F. Danforth, Syracuse, N. Y."

We also make a 10,000 meter tuner. Send 2-cent Stamp for Bulletin 107.

Just Out

Colby's Telegraph School
Auburn, N. Y.

undamped waves with an audion, with the addition of the inductances just described.

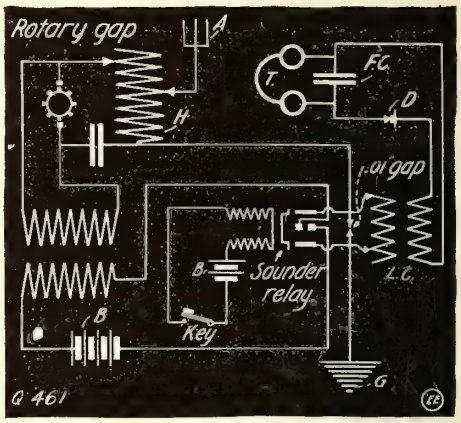
BREAK-IN SYSTEM.

(461.) Elmer C. Lundy, San José, Cal., asks: 1. The length of time for which an amateur license is issued. 2. What device will eliminate the flickering of the lights when operating a transformer on 110 volts a.c. 3. The connections for a satisfactory break-in system, using a rotary spark gap.

A. 1. An amateur operator's license is issued to cover a period of two years, while a station license is given for one year only. These licenses may be renewed by applying to the chief radio inspector of your district, sending him affidavits to the effect that the applicant's station has been in operation for the preceding six months.

A. 2. A kick-back preventer will sometimes help to eliminate the severe flickering of lights caused by the operation of a transformer on 110-volt a.c. lines, but a choke coil is invariably required in series with primary circuit.

A. 3. The illustration herewith shows



Break-in Hook-up for Radio Sending and Receiving Circuits.

the connections of a break-in system, including a rotary spark gap in the transmitter.

KITE AERIALS.

(462.) Ira Hull, Zenith, Kan., wishes advice: 1. As to the size of wire suitable for an aerial that is to be supported by a Malay kite. 2. The number of feet of wire which said kite can support. 3. The wave length that can be tuned with such an antenna, one loose coupler and one loading coil.

A. 1. No. 22 B. & S. bare copper wire can be used with success for the aerial supported by a Malay kite.

A. 2. The kite will be able to carry about 1,000 feet, although this length could be increased by using finer wire.

A. 3. The wave length to which you could tune with this outfit would be about 8,000 meters.

REGARDING WAVE LENGTHS.

(463.) Henry Gerke, Westwood, N. J., wants to know: 1. The wave length of W. C. C. 2. The wave length and the time at which W. H. B. sends "press." 3. Where he can obtain copies of (a) United States Naval Radio Regulations. (b) Regulations Governing Radio Communication. Act of Aug. 13, 1912. (c) Berlin International Radiotelegraphic Convention and Regulations.

A. 1. The wave length on which W. C. C. operates varies from 12,000 to 15,000 meters.

A. 2. The time at which W. H. B. usually sends "press" is 10.15 p.m., and the wave length on which he operates is 600 meters.

A. 3. The copies of these books can be obtained from the United States Printing Office, Washington, D. C.

TELEGRAPHONE TALKING HEAD.

(464.) Radio Amateur, Irvington-on-Hudson, N. Y., wishes us to tell him: 1. Can the armature of a telephone magneto be used in the construction of a telegraphone, if a hole is bored lengthwise through the center of it. 2. Is a pair of 1,000 ohm receivers more sensitive than a single receiver wound up 2,000 ohms.

A. 1. We do not believe that the armature of a telephone magneto can be used in the construction of a telegraphone head.

A. 2. A pair of 1,000 ohm receivers are more sensitive than a single receiver wound to 2,000 ohms. This is due to the fact that the two phones act on both ears simultaneously.

CHEMICALS.

(465.) K. Beymer, Dayton, O., wishes us to give him the name of a house where he may obtain chemical apparatus and chemicals.

A. Eimer & Amend at 211 Third avenue, New York City, should be able to supply your wants for chemical apparatus and chemicals. We would suggest that you write to them for prices and catalog. Also refer to our advertising columns.

SPECIAL ELECTRIC BULBS.

(466.) J. H. Kahler, Rochester, Minn., wants to know: 1. Where he can obtain special electric light bulbs. 2. Where he can have special mercury vapor arcs made. 3. Whether a variable condenser is better than a fixed type when it is used in shunt with wireless 'phones.

A. 1. For these bulbs we would refer you to General Electric Lamp Works, Harrison, N. J., who will doubtless be able to make them for you.

A. 2. These lamps could be built by the firm mentioned in Answer 1, or by the Cooper-Hewitt Electric Co., Hoboken, N. J. The latter company would probably be better able to do this work, as they make a specialty of manufacturing mercury vapor lamps.

A. 3. It would be far more advisable for you to connect a variable or adjustable condenser in shunt with the receivers than a fixed one.

TOOLS.

(467.) Godfrey S. Bloch, New York City, wishes to know what we consider the 12 most important hand tools used by a machinist.

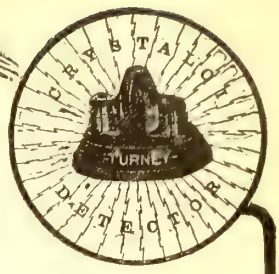
A. The 12 most important tools used every day by machinists and electricians are as follows: Hammer, screw-driver, pliers, hack saw, hand drill, dividers, calipers, chisel, wrench, drill, blow-torch and vise.

INDUCTION MOTOR.

(468.) Ervin R. Musgrove, Longmont, Colo., asks several questions relative to induction motors: 1. About a motor to be operated on a.c. and having an armature composed of copper bars and laminated iron discs, but not fitted with any commutator or slip rings. 2. On the constructional details of such a motor. 3. The reason why different results are obtained when applying Ohm's law to a.c. circuits as compared to d.c.

A. 1. The motor you are interested in falls into the category of induction machines. No commutator or slip rings for conveying current from the outside or feed circuit to the armature winding are necessary as the armature or "rotor," as it is called, has currents induced in its short-circuited windings from the magnetized





5000 miles—
From Hawaii to Richmond, Va.—
with
CRYSTALOI

"On Dec. 23 I made what I believe to be a new record for the Crystaloi Detector. About 11 P. M. I heard the station at Lahaina, Hawaiian Islands, a distance of 5,000 miles. Heard the station four different times.
(Signed) RALPH J. ROBEY, 3314 Floyd Ave., Richmond, Va."

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WIRELESS DETECTOR

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Crystaloi offers a large surface of highly sensitive mineral, which is brought into contact with a finely divided alloy—thus giving innumerable contact points. By rotating the cylinder the most sensitive spot is found immediately.

What It Does

Crystaloi will work under the heaviest static conditions—will not burn out—and with proper use will last a lifetime. With it every message will come in strong and clear.

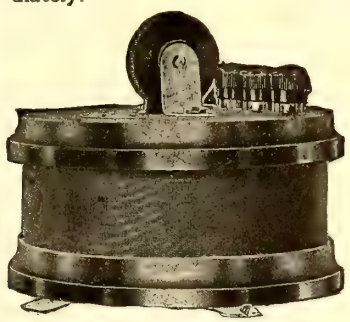
3 TYPES

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TYPE O—Dimensions 2¼" x 1⅞". **Price, $3.50.** Postage 10c

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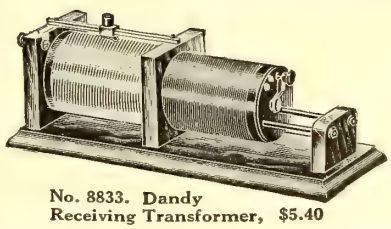
TYPE BB—Equipped with cohering inductance, fixed condenser, buzzer, test, batteries and control. Dimensions 7½" x5½" x 3½". **Price, $12.00.** Mail. Wght. 4 lbs.



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Send 5c. in stamps for Catalog "C" fully describing Crystaloi and all of our other High Class Receiving Apparatus.

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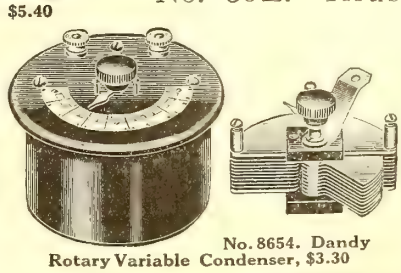


No. 8833. Dandy Receiving Transformer, $5.40

Are *You* looking for *Quality—Design* and *Workmanship* consistent with price?

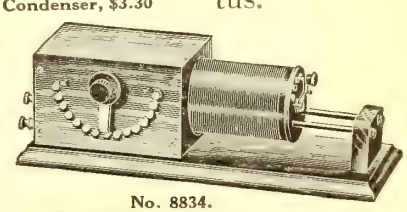
If you are, then get our catalog No. 36E. Illustrating and describing about **300** articles of Amateur-Radio Telegraph apparatus.

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No. 8834. Jove Receiving Transformer, $7.50

SUPERIOR MIGNON SYSTEM RADIO APPARATUS

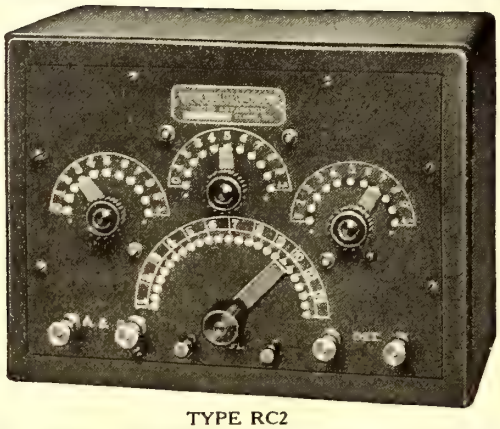
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Apparatus of Scientific Construction for the Reduction of Static Interference

High Resonance—Unapproached Selectivity

NO TICKERS NOR ARMSTRONG CIRCUITS REQUIRED for the reception of **CONTINUOUS** wave signals if you own a

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BRANDES RECEIVERS

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Write for R6 Catalog, Dept. "B"

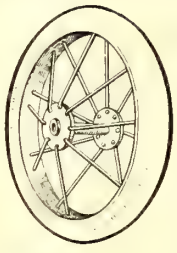
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The following are just a few of the hundreds of items with which we can supply you. Every "Ideal" article is priced as low as is consistent with the quality. If you don't see what you need listed here, write us and tell us just what you want. Your order will receive our prompt and careful attention. Satisfaction guaranteed or money refunded.



PROPELLERS

accurately made of carefully selected wood. All types carried in stock from 6 inches up to 24 inches; made to order up to 7 feet.



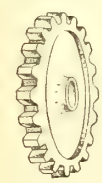
AXLES

Made of best quality steel rod. Being threaded on both ends and having nuts, they are very fine for CONNECTING TUNERS' ENDS AND LOOSE COUPLER SECONDARIES. Also made in brass at extra charge. 1/16 in. axles up to 6 in., 10c.; 7 to 10 in., 15c.; 11 to 15 in., 20c. 1/8 in. axles up to 6 in., 15c.; 7 to 10 in., 20c.; 11 to 15 in., 25c. Postage, 2c. extra.

"Ideal" Ball Bearing Propeller Shafts

These are perfect miniature non-friction Ball Bearing Shafts made precisely like the ball bearings used on large machines. They are perfectly constructed, have solid turned bearings and the finest steel balls and races. Flanges are drilled and ends of shafts are threaded and supplied with nuts and washers. *Flanges and upper ball-bearing cases are in solid piece of brass; not soldered and therefore unbreakable.*

No. 1—1/16 in. steel shaft. Weight 1.3 oz. Price, 50c.
No. 2—1/8 in. steel shaft. Weight 1.2 oz. Price, 60c.
Postage, 2c. extra.

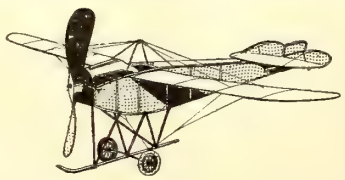


GEARS

Clean cut, made right; run smoothly without noise or friction. Have 1/16 in. shaft hole but can be furnished with 1/8 in. hole at 10c. each additional. Postage, 2c. extra for each gear.

Size	No. of Teeth	Pitch	Price
5/8 in.	18	32	.15
3/10 in.	10	40	.15
11/20 in.	20	40	.20
4/5 in.	30	40	.25

Build a FLYING Model War Aeroplane

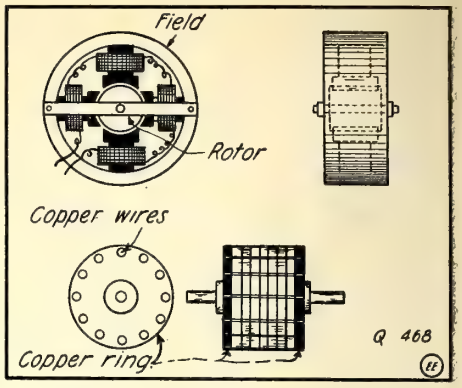


We can supply you with accurate scale drawings, instructions and all parts for the well-known types. For prices see our **interesting new 50-page catalogue.** All our experimenter's supplies are illustrated and described in this booklet. Write to-day for a copy. Price, 5c. postpaid.

SPECIAL ORDERS are promptly and carefully executed by our Mechanical Department. Submit us your drawings and specifications for quotations.

IDEAL AEROPLANE & SUPPLY CO. **76-82 West Broadway, New York**

field. This field is provided with a plurality of windings which are connected to the external source or exciting energy. Induction motors are supplied for either single



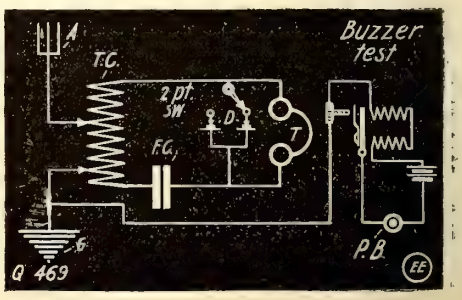
Assembly and Parts of Induction Motor.

or multi-phase circuits; the larger size motors being invariably supplied only for two or three-phase supply. Special windings and starting provisions have to be made for such motors, when adapted for use on single-phase a.c. circuits.

A. 2. Herewith the illustration showing the make-up of the induction motor. The rotating member consists of a number of soft steel discs mounted rigidly on a shaft in the usual manner. These are slotted similarly to a d.c. motor armature, but instead of being wound with coils comprising a large number of turns of wire, each slot receives a single, heavy copper rod or bar. Two heavy copper rings are placed on either rotor end and the copper bars in the slots are firmly riveted or soldered to these rings; thus there are provided a plurality of closed electrical circuits through the end connecting rings or discs and the inductor bars within the slots.

A four-pole field, made up of laminated annealed steel discs, is here indicated, but this is only used in most cases for small, single-phase fan motors and the like. In larger multi-phase motors the field has a large number of slots in the periphery of the rotor opening, which resemble almost identically the peripheral appearance of the rotor. In the stator slots appropriate windings are placed, consisting of coils of magnet wire. The rotor is moved or pulled around by the constantly changing rotating a.c. magnetic field set up by the stator windings.

A. 3. The reason that you obtain different results when using Ohm's law with a.c. circuit is that this law does not apply to a.c. circuits but only to d.c. circuits, due to the former manifesting marked capacity and inductive effects, which throw the current and voltage out of phase or synchronism.



Radio Receiving Hook-up.

THE TESLA PLANT.

(469.) Chas. W. Squires, Port Jefferson, L. I., N. Y., wants us to give: 1. The correct hook-up for a receiving set consist-

ing of two slide tuning coils, two detectors, silicon and galena, two-point switch to throw on either one, test buzzer for detectors and 75 ohm receiver. 2. The wave length of a two-slide tuning coil wound with 128 feet of No. 24 bare copper wire. 3. The location of Nikola Tesla's plant on Long Island.

A. 1. The illustration herewith given shows the proper connections for these instruments.

A. 2. The wave length of the tuning coil would be about 450 meters.

A. 3. This plant is located at Shoreham, L. I.

STEEL WIRE.

(470.) Edward L. Jewett, Sullivan, N. H., inquires of this department: 1. Where he can obtain long lengths of steel wire for use in the telegraphone, described in the June, 1915, issue of *The Electrical Experimenter*. 2. The difference between No. 32 steel piano wire and No. 32 B. & S. gauge wire.

A. 1. The steel wire used in the telegraphone can be bought in any desired length from most hardware stores.

A. 2. There is a difference between the diameter of wire designated as "No. 32 steel piano wire" and "No. 32 B. & S. wire," as the gauge used for measuring steel wire is not the same as that used for copper. The latter refers to the Brown & Sharpe standard gauge.

WIRELESS SCOUTS HONORED.

H. B. Thayer, president of the Western Electric Co., gave a dinner at the Hotel Astor recently in honor of the men who went to the far corners of the earth to receive the wireless telephone messages recently sent from Arlington, Va., and which were heard in Paris and Honolulu.

ELECTRICITY ON OCEAN LINERS.

(*Continued from page* 611.)

in the house. There are two complete sets of apparatus, one for transmitting and one for receiving messages, the latter being placed in a sound-proof chamber in one corner of the house. There is also an independent storage battery and coil.

For submarine signaling apparatus is provided for receiving signals from submerged bells. Small tanks containing microphones are placed on the inside of the hull of the vessel on the port and starboard sides below water level and connected by wires to receivers situated in the port navigating room. The whistles are electrically actuated. The boiler-room telegraphs, stoking indicators and a number of auxiliary appliances, such as rudder indicators, clocks and thermostats, are also electrical, and the water-tight doors are released by electromagnets.

There are complete emergency circuits provided on all ocean liners. A separate and distinct installation is fitted in all parts of the vessel, deriving current from two

MARKO STORAGE BATTERY



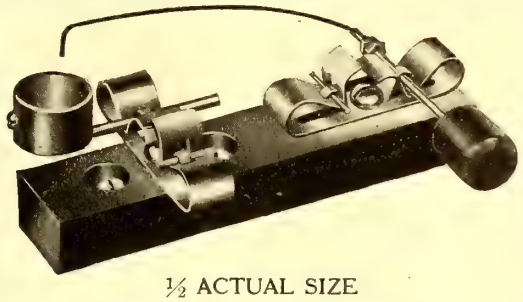
TYPE 6WT8

Type	Volts	Amp. hr. capacity	Length	Width	Height	Special price to wireless engineers
4WT4	4	40–60	5¼	7⅛	8	$7.87
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Especially adapted for Audion use.
It is a well-known fact among up-to-date wireless engineers and experimenters that the Audion operates at a higher efficiency when controlled by a storage battery that gives constant voltage.
MARKO Batteries are fully guaranteed, and designed to meet these conditions.
Descriptive circular on all types of MARKO Storage Batteries upon request.
Guaranteed highest quality and lowest prices.

MARK O' QUALITY

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½ ACTUAL SIZE

POSTPAID, 50 CENTS

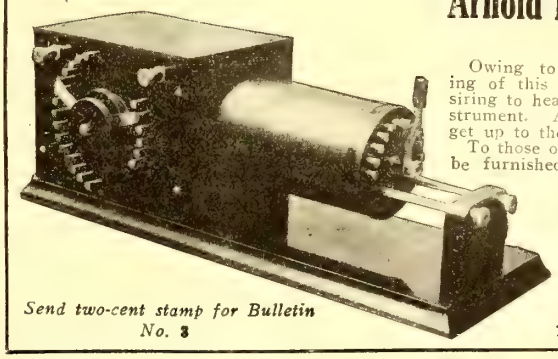
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Absolutely the simplest and most practical Detector of the Cat Whisker type yet devised. Lacquered Brass for the metal parts and Polished Fibre for the base.

Has the usual merit of the "Winger" products.

Winger Electric & Mfg. Co.

711 So. Dearborn Street, Chicago, Ill.



Send two-cent stamp for Bulletin No. 3

Arnold Navy Type Loose Coupler

PRICE, $15.00

Owing to the peculiar construction and winding of this instrument it is possible for those desiring to hear the Arc Stations, to do so on this instrument. A special Hook-up is needed in order to get up to the wave length.

To those ordering an instrument such Hook-up will be furnished gratis.

It is as in the past the Right instrument to do all first class receiving with. Workmanship and material the best.

Send 2-cent stamp for Bulletin No. 3, which describes fully, also shows the finest line of Switch points, Rubber knobs and accessories on the Market.

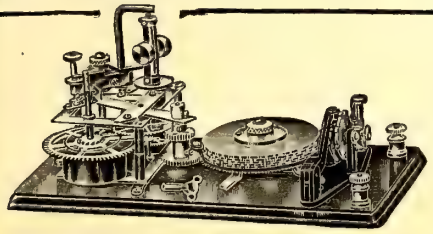
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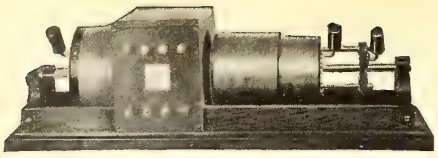


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Type AML

The Precision Varicoupler

Patented Mar. 7, 1916, foreign patents pending.

Up-to-date receiving circuits require improved apparatus. You can't get supersensitiveness with old style couplers. The Precision Varicoupler is PERFECTION in receiving tuners. It has

No Taps	No Sliders
No Switches	No Delicate Parts
No "Dead Ends"	All the Wire in
No Contacts	Use all the Time

and is finished in mission oak, genuine cut hard rubber, silver finished wire, etc.

5 Styles, $10 to $25

For detailed information write for bulletin PL.

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AUDIO TRON

BULBS $6.50

SENSITIVENESS GUARANTEED

200 PER CENT. MORE
SENSITIVE THAN ANY OTHER MAKE
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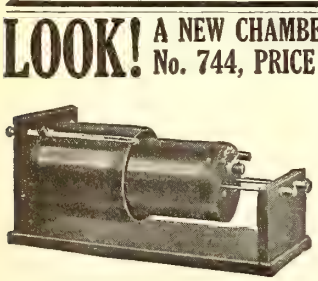
is the record (amateur) with our Audio-Tron Detector

THE AUDIO-TRON
DETECTOR—AMPLIFIER—OSCILLATOR

Price postpaid $6.50

Jensen Electric Co.
RADIO APPARATUS
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SEND STAMP FOR CATALOG
1949 Huron Street CHICAGO, ILL.

LOOK! A NEW CHAMBERS COUPLER No. 744, PRICE ONLY $4.50



Positively unequaled for the money. Is 6" high, 6" wide, and 14" over all. Wound with Enameled wire, and has a very unique slider. Woodwork mahogany finished. Try one, you will not be disappointed.

5c. in stamps brings our 64-page illustrated catalogue, B-B-24. None otherwise.

F. B. Chambers & Co. 2046 Arch Street Philadelphia, Pa.

30-kw. sets and the 3,500-ampere-hour battery, so that in the event of current from the main dynamos being unavailable an independent supply is obtainable. Connected to the emergency circuit are about 500 incandescent lamps, fitted throughout all passenger, crew and machinery compartments, at the end of passages and near stairways; also on boat deck, to enable anyone to find the way from one part of the ship to the other. The following are also connected to the emergency circuit by means of change-over switches: Five arc lamps, seven cargo and gangway lanterns, wireless apparatus, boat davits, mast, side and stern lights and all lights on bridge, including those of navigating and chart rooms, wheel house, telegraphs, compasses and Morse signaling lanterns.

Very soon, it is freely predicted, ocean liners will also be driven by electric power, the Government having ordered such an electrical equipment from the General Electric Co. to drive the new battleship California, the largest in the world.

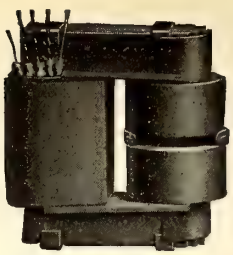
ELECTRICITY, THE BENEFICIENT.

(*Continued from page 619.*)

great aluminum industry with all its branches, for instance, is directly dependent upon the electric current for the production of the aluminum itself. Acetylene gas which is now used for so many purposes is obtained from calcium carbide, which is produced by means of the electric current. Carborundum, the well-known and widely used abrasive, is a product of one form of the electric furnace. The electric current is used in refining copper on a vast scale, for the purpose of purifying it and for the separation of the precious metals. Numerous other chemical industries are founded upon the use of the electric current. Fixation of atmospheric nitrogen for producing nitrates for fertilizing and other purposes is now accomplished on a large scale by means of the electric current, and it promises to become in time one of the vastest industries in the whole world. In fact, power plants of approximately half a million kilowatts, or more than three-quarters of a million horsepower, concentrated in a single station are now being considered for such production of nitrates. The time is coming when the whole world will be affected by this industry through food production.

Such a catacylsm as the complete cessation of all electrical activities would therefore result in such changes as greatly increased concentration of population around industrial centers, the city and the country would be pushed farther apart, many industries would be disorganized and some would be stopped completely, many great establishments would have to be reconstructed, types of buildings would be changed, methods of business would be modified, the producing capacity of individuals and of industries would be greatly reduced, methods of living would be modified, methods of transportation would be changed and for the worse; in fact, all conditions of life and fields of endeavor would be influenced, either directly or indirectly.

Myriads of times it has been said that "electricity is in its infancy," until people have come to believe that it is a perpetual infant like Buster Brown for instance, but it has now grown to robust stature and unostentatiously has assumed a goodly share of the world's burdens. Its efforts have been productive and not destructive. In this sense it has been one of the most beneficent agents of mankind. In Arabian Nights' parlance it is one of the good genii.



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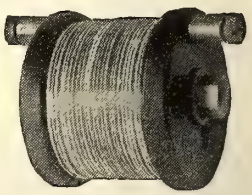
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PATENT ADVICE

Edited by H. GERNSBACK

In this Department we will publish such matter as is of interest to inventors and particularly to those who are in doubt as to certain Patent Phases. Questions addressed to "Patent Advice" cannot be answered by mail. Sketches and descriptions must be clear and explicit. Only one side of sheet should be written on.

FREIGHT CAR LOCK.

(47.) Elmer D. Gehman, Macungie, Pa., desires to have our advice on a freight car door lock which he has invented. He submits description and illustrations of same.

A. The idea to us seems novel and as far as we have ascertained by a careful examination of our files and reference books nothing like the idea submitted is in existence so far. We would, however, advise our correspondent to get in touch at once with a patent attorney to find out what has been done in the art before. It will only cost a small sum of money to get the references of other patents that have been obtained on such locks, and they perhaps will show our correspondent how to go about getting a valuable patent on the invention.

NON-REFILLABLE BOTTLE.

(48.) Ralph H. Zimmermann, Sutton, Neb., desires to know if there is such a thing as a simple and practical non-refillable bottle, and whether one is on the market and in actual use. He also wishes to know if it is worth while to spend time and money in the invention of such a bottle.

A. As stated before to another correspondent, several thousand patents have been taken out on non-refillable bottles, and as far as we are aware, there are not six being used at the present time. The ones that use them are mostly the liquor people, to whose interest it is to see that the bottle is not refilled after its contents have once been emptied.

We have stated the case clearly above and our advice to inventors of non-refillable bottles is that they should not waste a lot of time and money inventing one, as practically everything has been attempted in this art, and several very good ideas are in actual use to-day.

As far as we are concerned, there is no such thing as a non-refillable bottle, as any non-refillable bottle, no matter how well constructed, can be refilled if anybody really wants to do so.

We know of a case where an unscrupulous bartender removed the label of a liquor bottle, the brand of which had a very wide sale. After removing the label, a small hole about ⅛ in. in diameter was drilled into the bottle, and by using an ordinary suction pump the bottle could thus be refilled quite easily with an inferior brand. The small hole was plugged up with cement and the label again placed on the bottle. Consequently the non-refillable bottle could be refilled in spite of the fact that this was about the best bottle of this kind on the market. While such cases are of course infrequent, it still goes to show that where there is a will there is a way.

COMMUTATORLESS D. C. GENERATOR.

(49.) Clarence Ray, Kokomo, Ind., has submitted to us an elaborate set of drawings and description about a commutatorless d.c. generator, and he wants to know what demand there would be for a machine of this kind, and, if possible, its value financially. The dynamo in question works without commutator, as its name implies, and is supposed to have a much larger efficiency than other generators of the same kind.

A. As stated before in these columns, this journal cannot give advice as to the financial value of an invention. We stated before that even if we were to put down a figure this would at best be but a crude guess, as it would be practically impossible to approach the true value within 90 per cent., no matter what the invention was.

As far as the dynamo is concerned as submitted by our correspondent, we must say that we have been very favorably impressed with the idea. We have never seen anything like it, and from a careful study which we have made of the device we are quite convinced that it will work as stated by our correspondent. It is certainly the most ingenious invention which has been submitted to us so far, and should prove of great interest to manufacturers constructing generators. As far as we are aware of, there exists to-day no machine nor patent on a generator of this kind, and we would advise our correspondent to get in touch with a patent attorney at once and see what has been done in the art before. There is a chance that a similar idea might have been patented before, although we very much doubt it.

We have been so well impressed with this invention that we would like our correspondent to advise us what results he has had in connection with the device.

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Thomas A. Edison was born at Milan, O., in 1847, but when he was seven years of age his family moved to Port Huron, Mich., where he passed his boyhood. Edison spent but three months in the public schools, but received a thorough schooling at his mother's knee. Before he reached the age of twelve he had read Gibbon's "Rome," Hume's "History of England," Sears' "History of the World," and the "Dictionary of the Sciences."

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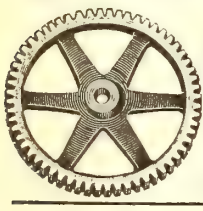
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BARON MÜNCHHAUSEN'S NEW SCIENTIFIC ADVENTURES.

(*Continued from page* 625.)

soned with a similar logic, and they had thus come to the conclusion that as Mars is so far removed from our sun the temperature on Mars must necessarily always be far below the freezing point. Accordingly they reasoned that life on Mars as we understand it was not possible. But then the telescope suddenly revealed that the Martian snowcaps *do* melt every spring, and if this is the case the temperature even in the arctic circles at times *must* be above the freezing point. But why?

"'The answer is simple enough. The earth has a very dense atmosphere with many clouds. On Mars the reverse is the case, where we have a thin atmosphere and practically no clouds all year around.

"'Professor Lowell estimates that over the earth as a whole the proportion of actual to possible sunshine for the entire year is 50 per cent. In other words, the sun only shines practically one-half of the time it might if there were no clouds. On Mars, on the other hand, the sun shines 99 per cent. of the time. There are no cooling rains or snows in the temperate zones either to cool the atmosphere, consequently a great deal more heat is absorbed and retained on Mars than is the case on earth. Further, an enormous amount of energy is lost on earth, where the sun rays must travel through a dense blanket of air, which is not the case on Mars, where the air is thin and clear. For this and other reasons too technical to dwell upon, we find that light and heat are practically the same on the two planets, with several points in favor of Mars.'

"While I was still turning these facts over in my mind, Flitternix suddenly pointed to the sky and shouted rather excitedly:

"'Look at the moons!' I followed his finger and I saw the wonderful spectacle of two full moons shining in the sky. It was still light and for that reason the effect was not as wonderful as we have since witnessed when we see Phobos and Deimos during the night time. At that particular time the moons shone rather pale as our own moon does in a bright afternoon with the sun still up.

"Phobos, the larger of the two moons, is but 4,000 miles distant from Mars and, as I mentioned before, it revolves around Mars in the incredible short time of 7½ hours. In a single Martian day it therefore revolves three times around Mars, consequently it rotates faster than Mars itself. Although it revolves in the same direction as Mars and the rest of the planets, namely, from west to east, on account of its greater speed *it appears as if it were moving from west to east.* Its speed to an unaccustomed human observer is really disquieting. While we were looking on we could actually see how terrifically fast Phobos moves. When Flitternix had first called my attention to it it was quite high up in the sky. Ten minutes later we watched it plunge with express speed below the eastern horizon! It is positively uncanny to see a heavenly body that looks as big as our moon perform such celestial gymnastics, but the fact remains. Deimos, the smaller of the two moons, revolves at a distance of 12,300 miles from Mars. But as it measures but 36 miles in diameter it naturally appears quite small as seen from Mars, even when full. At that afternoon when we saw it it did not appear very much brighter or bigger than the evening star as seen from the earth. As a matter of fact, it does not look like a moon at all

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to Martians, as we understand that term; it looks rather like a very bright star. Even during the night its face does not always appear as a disc to the naked eye, even when it is full. It is too small and too far removed. Nevertheless it is a true moon.

"Having finished our contemplation of the sky, we turned anew to the view directly below us. Of all inspiring and majestic sights I do not think that there is one that can rival a Martian 'city.' I once thought that New York as seen from the Woolworth building was about the grandest view one could ask for, but it appears positively ridiculous compared with any of the Martian great centers.

"To begin with, the Martian cities are not built upon the ground for a very important reason. Nearly all of the Martian continents are deserts, irrigated only in comparatively small sections and near the great waterways. The land, therefore, which is absolutely flat without even small elevations, is sandy, as are all true deserts. For ages upon ages this desert sand has been rolling back and forward over the planet till it has lost the characteristics of real desert sand as you know it on earth. It has become a fine, impalpable dust, extremely choking if it finds its way into the lungs.

"This fine desert dust is the greatest bane of the Martians and they fight it constantly and heroically. But as nothing but vegetation—which, again, is dependent on water—will permanently stop the dust, the fight is almost hopeless, for the Martians lack water to irrigate the entire planet. Naturally the dust is not quite so bad near the waterways, but the large centers spreading for a few miles inland are not thus protected, especially if the wind blows from the land side over a broad expanse of desert. Even the slightest breeze brings its clouds of choking dust and a strong wind sometimes obscures the sky.

"But when it storms pity the poor Martians! Through the large telescopes on earth 40 million miles away astronomers have frequently seen huge sandstorms sweep over sections of Mars as large as France! Can you imagine what such a storm means? We witnessed one yesterday and it was awe-inspiring, terrific indeed. Hours ahead of the storm the Martians ran for their sheltered lofty houses and closed everything airtight. All traffic on the canals, on the ground, as well as in the air, ceased for two hours while the storm was in progress. From the eastern side of our host's windows we saw the approach of the dust. It came rolling on in gigantic red clouds like an ocean, and although it was in the forenoon the sun was blotted out almost entirely. The dust is so fine that you could hardly hear it as it was hurled against the thick window panes in immense quantities. On and on it came, seemingly without end; sometimes we would get a glimpse of sunlight, but oftener we were plunged in total darkness. After the storm had lasted for two hours it stopped as suddenly as it had appeared and the sun smiled down on us again as always.

"Within ten minutes after the storm myriads of aerial flyers could be seen spraying the buildings and structures with compressed air to clean out the red dust from the corners where it had accumulated. When we looked around this morning there was hardly any evidence of the terrific sandstorm of yesterday. Of course, such storms as the one we witnessed are rare and do not occur more than six times a year; nevertheless, all Martian houses and structures are built with a view of getting rid of the dust as quickly as possible when it does come in avalanches.

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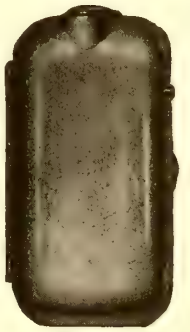
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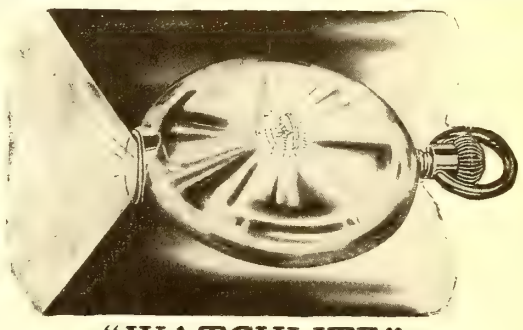
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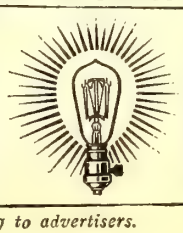
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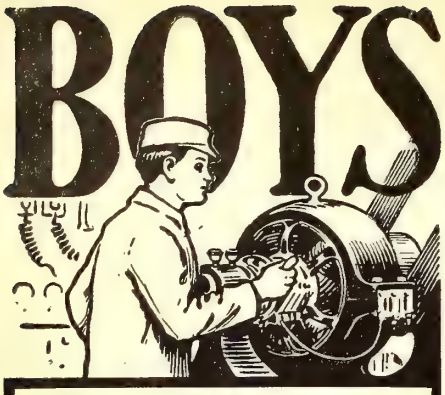
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gable or pyramid roofs, and every wall and balustrade is built with a gable. Every window sill points downward at an angle. There is not a structure on Mars that is exposed which is flat, or which has a single flat projection extending from it. Everything is built to get rid of the dust as quickly as possible, for this fine and extremely dry sand slides down a sharp incline with great rapidity.

"From the foregoing you will easily understand that the Martians cannot permanently dwell near the ground. It is an exceptionally calm day when your Martian can walk on his planet without his respirator hood over his head. From this it follows that as he cannot dwell upon the ground, and as intelligent beings as a rule do not care to burrow themselves into the ground, there is but one thing to do, and that is to go above the surface of the ground. Indeed, this is precisely what the Martians have been forced to do for thousands of years back.

"It was soon found that the ordinary dust did not usually rise higher than 400 feet above the surface of the planet. At this altitude the air is sandproof except for such severe storms as the one we witnessed yesterday.

"For this reason all buildings and structures on Mars, with few exceptions, are located 500 feet above the ground in order to make life bearable. Thus all 'cities' are built high up in the air, and it is this feature which gives the stranger his greatest surprise.

"Imagine immense metal towers stretching skyward mile upon mile, supporting a vast city raised 500 feet up in the air. Imagine these towers partly roofed over with metallic roadways and buildings and you have a faint idea of how a Martian 'city' appears.

"When we had first 'landed' on Mars we naturally thought that we had touched the ground. As a matter of fact, we had not 'landed' at all, but we were still 500 feet away from Mars proper. We simply had descended in the aerial Martian city, but this we did not know till later.

"Every building is constructed of the universal transparent material *Tos,* giving the structures a curious but pleasing appearance. The transparency of this wonderful material is so great that it is possible to actually look straight through an entire building, wherever there are no obstructions of opaque objects. I might say that the latter are rare, for the Martian loves nothing better than transparency and for that reason he builds nearly every object of *Tos;* from a table down to the floor, which, of course, is transparent, too. You might think that such a house, open to everybody's curiosity would bring with it many delicate as well as embarrassing situations, but this is not the case, at least not for the Martians. These people have long since learned that anything worth doing cannot possibly be open to criticism from fellow inhabitants; while closeted, non-transparent rooms make for nothing but laziness and vice. When all of your actions are open to the entire world you are more apt to lead an upright life than otherwise. For that reason no false, make-believe civilization exists on Mars as is the case on earth. For that reason, too, the Martian is an upright, healthy, truth-loving individual, not a hypocrite as are nine-tenths of the human race. The Martian has no secrets, he knows no vice, he has no scandals, and he has little occasion to feel ashamed of himself. Why? Because everyone can see at *all* times what he is doing.

"Pick up any one of your newspapers. What do their text pages contain? Seventy

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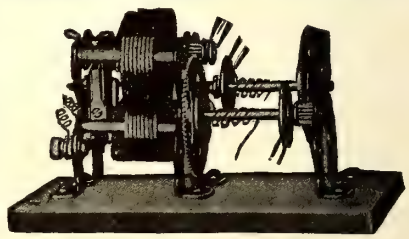
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"The great Martian 'cities' are laid out in semi-circles, or else rectangles, always one side quite close to a waterway. Moreover the 'cities' are not detached, but they are continuous; by that I mean that they run unendingly along the whole length of nearly every waterway. Thus on both sides of the waterways you will find the metal towers bearing on their top the Martian buildings. The so-called 'running cities' are only about one mile wide, running parallel with the 'canals.' Every 50 or 100 miles we find a large center which spreads out in form of a semi-circle or a huge rectangle, some of these large 'cities' recede from five to seven miles from the waterways. Of course, these large 'cities' are connected on both ends with the 'running cities'; for that reason there is no beginning and no end to the Martian 'towns.' Nor do they go by any particular name. Each spreading city has a number while the running ones, located between the spreading ones, have a figure and a symbol like our letters. Thus the Martian Capital at which we reside at present is termed 1. The first large 'city' toward the south is termed 2. The 'running city' which connects city 1 and 2 is termed 1A. Of course, the Martian symbol is not 'A,' this is merely my equivalent or my own translation for it. The numbers of the houses for quick orientation are termed in 'fractions,' according to their location. Thus, for instance, a house located in the 'running city' 1A is numbered $\frac{1A}{10}$. This means that it is the tenth house south, counting from the 'city' 1. As every Martian knows the location of every 'town,' the numbering system is both simple and does not lend itself to confusion.

"As nearly all of the land on Mars is practically desert, except that near the waterways, it follows that no 'town' ever reaches more than 10 miles inland. This fully explains the vast 'connecting cities.'

"All the streets run perfectly straight and cross at right angles, American fashion. All buildings and houses are detached from each other, none are ever found built close together. Usually eight buildings constitute a 'block,' three to each side, with the center space left open.

"The 'blocks' are separated by wide arched roadways; wherever two of them cross each other, there are usually two bridges flung diagonally across which meet in the center.

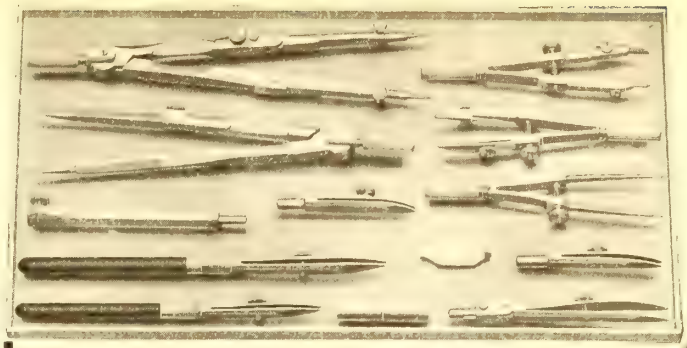
"The roadways themselves are of a heavy metallic construction and are entirely perforated with round conical holes about one inch in diameter with about one inch of metal between them. By this method all dust and dirt falls through the streets to the ground 500 feet below. Thus the roads appear clean perpetually, even after a sandstorm. The houses.....but, hello, my chronometer tells me that I have but ten seconds left to talk before the telegraphone wire on my radiotomatic on the moon will be full to capacity. Well, good night, my boy, till to-morrow, good night!....."

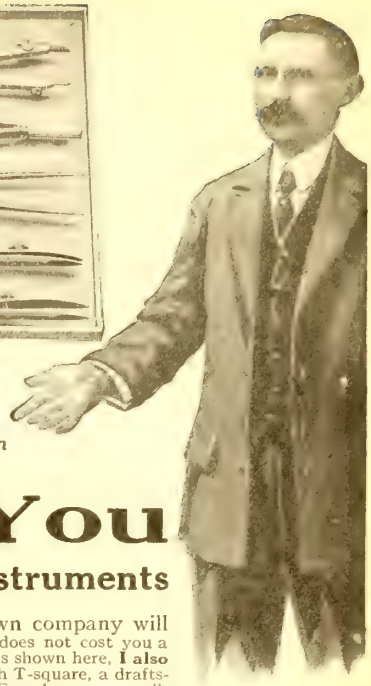
* * * * *

The usual rap, r-r-r-ap, f-flum, f-flumm and everything was quiet once more.

This serial started in the May, 1915, issue. Back numbers are supplied at 10 cents each.

(To be continued.)





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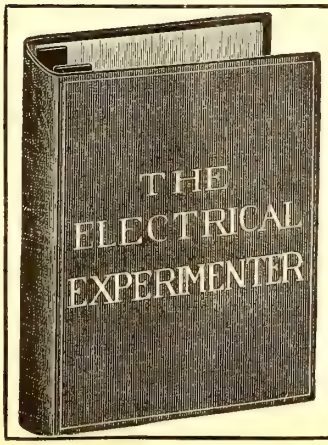
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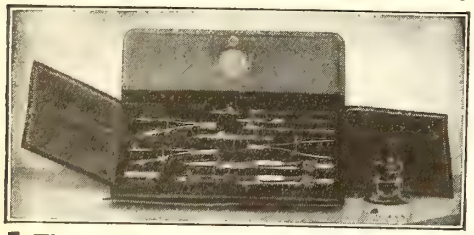
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THE UTILIZATION OF THE SUN'S ENERGY.

(*Continued from page* 606.)

a partial rotation to the ratchet wheel w. As the current ceases the armature is retracted by the spring b, without, however, moving the wheel w. With the stoppage of the current the plates t t cease to be attracted and separate, thus restoring the circuit to its original condition.

Coming now to later developments of a practical nature in the line of solar engines and boilers, we may take up the work of Mr. Shuman, of Philadelphia, Pa., who later collaborated with a Mr. Boys, of England. They were able in their final developments to operate a 100 horsepower engine by means of solar energy. This plant was built at Meadi on the Nile, Egypt, and is shown in the large illustration here reproduced at Fig. 3. Prior to this excellent work, however, we may consider briefly the early solar engines developed and tried out at Philadelphia, Pa., by Frank Shuman, upon which work he started in 1906.

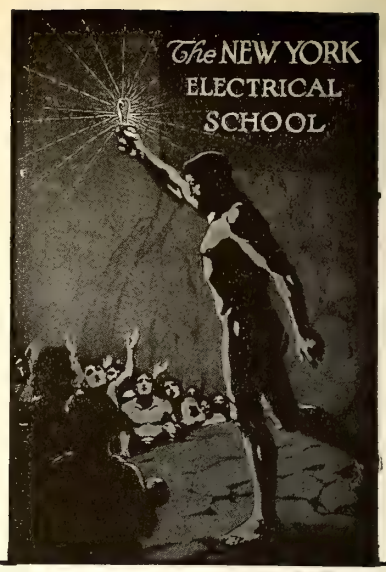
A year later he had running at Tacony, Pa., a practical plant of this type, which developed about 3½ horsepower by using 1,200 square feet of sunshine that was allowed to fall on a fixed, horizontal water box. This box was fitted with a glass top and a series of parallel horizontal black pipes were immersed in the water. These pipes, containing ether, exposed 900 square feet of surface to the solar radiation. The water also became heated and carried the heat to the underside of the pipes, thus realizing a greater efficiency. The ether boiled and its "steam" drove a small vertical, single cylinder engine. The exhaust ether vapor passed into an air surface condenser and the liquid ether from this was pumped back into the tubes of the sun boiler. It was found that this plant worked well even with snow on the ground, which is explainable from the fact that the permeability of the atmosphere is about 20 per cent. greater in winter than in summer.

Further tests and refinements to the Tacony plant by Mr. Shuman resulted in 1911 in an engine and boiler which showed considerable strides forward in their design, the ratio of 245 square feet of sunshine per one brake horsepower having been attained.

It may be mentioned here that the pipes constituting the sun boilers have invariably been *blackened*. For low temperatures lampblack has been used as the absorber, but where high temperatures were required platinum black was used.

The illustration Fig. 3 is that of the solar energy plant built at Meadi on the Nile, Egypt, by Messrs. Shuman and Boys in conjunction with several English scientists, including Mr. A. S. E. Ackerman, B.Sc. This plant made use of a 100 horsepower Shuman engine coupled with suitable auxiliary apparatus, as before mentioned. Five absorbers of the reflection type were utilized, as the illustration portrays. Each one measured 15 feet wide by 205 feet long. These were placed north and south geographically speaking, and were automatically heeled over, by being placed on suitable wheels, from an easterly aspect in the morning to a westerly one in the evening, so as to actually follow the sun. This caused an approximately even absorption of the solar rays all day.

The total area of sunshine so collected at this plant was 13,269 square feet. Cast iron boilers of suitable design were placed at the focus point of the reflectors, as shown in the illustration. They were covered with a single layer of glass which



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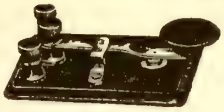


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SEE PAGE 661

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enclosed an air space around the boilers proper. The concentration value of this arrangement was 4½ to 1. The maximum pounds of steam generated was 12 pounds per 100 square feet of sunshine, or the equivalent, to 183 square feet per brake horsepower. The best hours' run developed, at atmospheric pressure, 1,442 pounds of steam. Hence (allowing 22 pounds steam per brake horsepower) the maximum output for an hour was 55.5 horsepower (about ten times better than any previous results). This means 63 brake horsepower per acre of land occupied by the plant. Moreover, no marked reduction in the horsepower produced was noticeable in the early hours of the morning or in the late hours of the afternoon.

The engineers of the concern which made these tests at Meadi recommended that such solar plants were feasible and practical and that undoubtedly they would be a very good thing in such arid regions for irrigation purposes. One argument brought against them, however, was that the power would not be available in cloudy weather, but then the irrigation would not be necessary, was the reply.

Thus the fight goes on between Dame Nature and the scientists. Whether we shall ever have an efficient solar boiler and engine is a problem worth thinking about and a very interesting one at that, as we possess no greater source of natural energy, to be had without taxation or special leases from some money-grabbing coal, oil or other baron, than that of the sun. Some day we may be able to derive all necessary light and power, for our homes at least, by means of a solar-electric plant located on the roof, and who shall say that we must be taxed for utilizing such energy?

THE TESLA HIGH FREQUENCY OSCILLATOR.

(*Continued from page* 615.)

thousands of horsepower? However, this figures out better than might be expected offhand. With an input of 300 kilowatts at the Tesla coil primary exciting such a structure and considering that this amount of energy is discharged through the earth in six-thousandths (.006) of a second, then the rate of liberation of the energy will be 120,000 horsepower.

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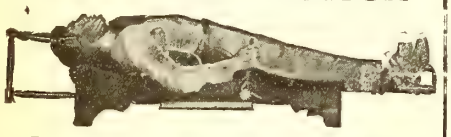
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HOW TO ORGANIZE AND CONDUCT A RADIO CLUB.

(*Continued from page 627.*)

ing and receiving sets constructed entirely by members of the club. The crowds of visitors evinced great interest in this particular feature of the exhibit.

The Atlanta Radio Club has an active membership of 25, each member possessing a complete sending and receiving station. A meeting is held every two weeks, at which many subjects of interest are discussed. The members converse every night with each other, the length of conversation, form of calling, signing, etc., all being done in strict conformance to certain by-laws of the club's constitution.

The club has a *special operator,* who sends out official notices to all members on a certain day and hour, and also has an *inspector of stations,* whose duty is to adjust each station so that it will cause a minimum of interference, and also to see that each station conforms to the Government radio regulations regarding wave length, power, etc.

A Club Laboratory.

Many amateur radio organizations have arranged in one way or another to fit up shop facilities for the use of the members. Special appropriations, obtained by outside contributions or by levying an assessment on the members of the club, have served to offset the cost of the machinery necessary. A small lathe is probably one of the most useful articles which a club should purchase for such a laboratory. This may be followed by a small drill press, another necessary accessory which the individual members would probably not have the good fortune to have the use of in their own homes or laboratories. Aside from such machinery necessary in winding coils, making up special apparatus parts, etc., there is a very urgent need for a good *wave meter,* and also, when possible, a *decremeter.* From the various magazine articles, particularly in *The Electrical Experimenter* for November, 1915, it is possible to build a fairly accurate wave meter without a special calibration against a standard wave meter. Any wave meter can be calibrated at a nominal expense by the Bureau of Standards, Washington, D. C. The secretary of the club should write to the bureau, obtaining in reply information as to the cost for calibrating the particular instrument in hand. Likewise, it is possible to have a decremeter calibrated. If access is had to any local school or college having such standard instrument on hand, it is possible that arrangements can be made with the instructor in charge to compare and check up the club's instrument with same.

[*Be sure to read the conclusion of this important article in the April issue. It takes up such timely subjects as the "Rules for Conducting a Meeting," "Order of Debate," "Formation of Club Library," "List of Most Desirable Books," etc.*—EDITOR.]

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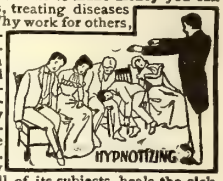
(*Continued from page 607.*)

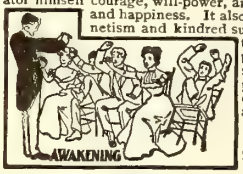
necessary to place within them a small piece of iron, so that the electro-magnets may attract them. Instruments which are operated by this method are depicted in Fig. 3. The one toward the right is an instrument which imitates a flute. The electro-magnets are placed underneath the tubes, which are made out of wood and act as resonant chambers. The magnets are caused to act on iron discs mounted at the lower end of the tube. Another style of flute instrument is illustrated in Fig. 4. This employs a different variety of tubes, ranging from a very high tone to a very

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low one. The smaller pipes emit the latter tone, while the larger ones produce the former.

The instrument shown in the center of Fig. 3 illustrates a brass chime. The tones are produced by hammers, each of the tubes being supplied with one. These are operated by electro-magnets, as perceived in the upper bracket of the stand. These are also connected to the same keyboard.

The very deep tones of an organ are produced by vibrating diaphragms placed beneath metal horns. A pair of electro-magnets are held a minute distance away from the diaphragm and serve to vibrate the latter when the pulsating current is applied. The volume of the tones are powerful and are very pleasant, although they are very low. By increasing the power in the electro-magnets the strength of the tones are so much increased that it is almost impossible to imagine the effect.

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We are indebted to Wilber E. Farrington, of the Choralcelo Co., for our illustrations.

MARVELS OF MODERN PHYSICS.

(*Continued from page* 623.)

a heat wave, that it had a density of about $\frac{2}{3} \times 10^{-20}$ pounds per cu. ft., which would make a volume of ether the size of the earth weigh only a small fraction of a pound.

Whether the ether is continuous or discontinuous, at least it is not matter in the ordinary sense, and it certainly is not atomic; that is, divisible into particles akin to atoms. There are no gaps as would exist between such particles, and the shortest light waves are carried by it as well as the longest. Likewise we now see that it is the universal medium of action for several different and wonderful forces.

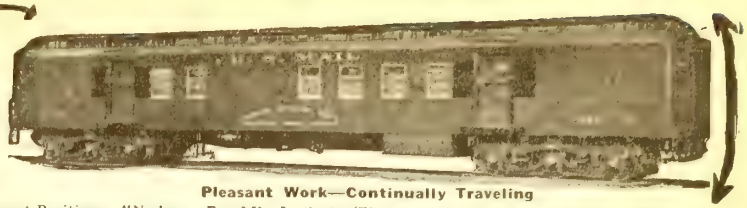
To gain a mental picture of this medium let us consider a hollow sphere H, H^1, as in

(*Continued on page* 667.)

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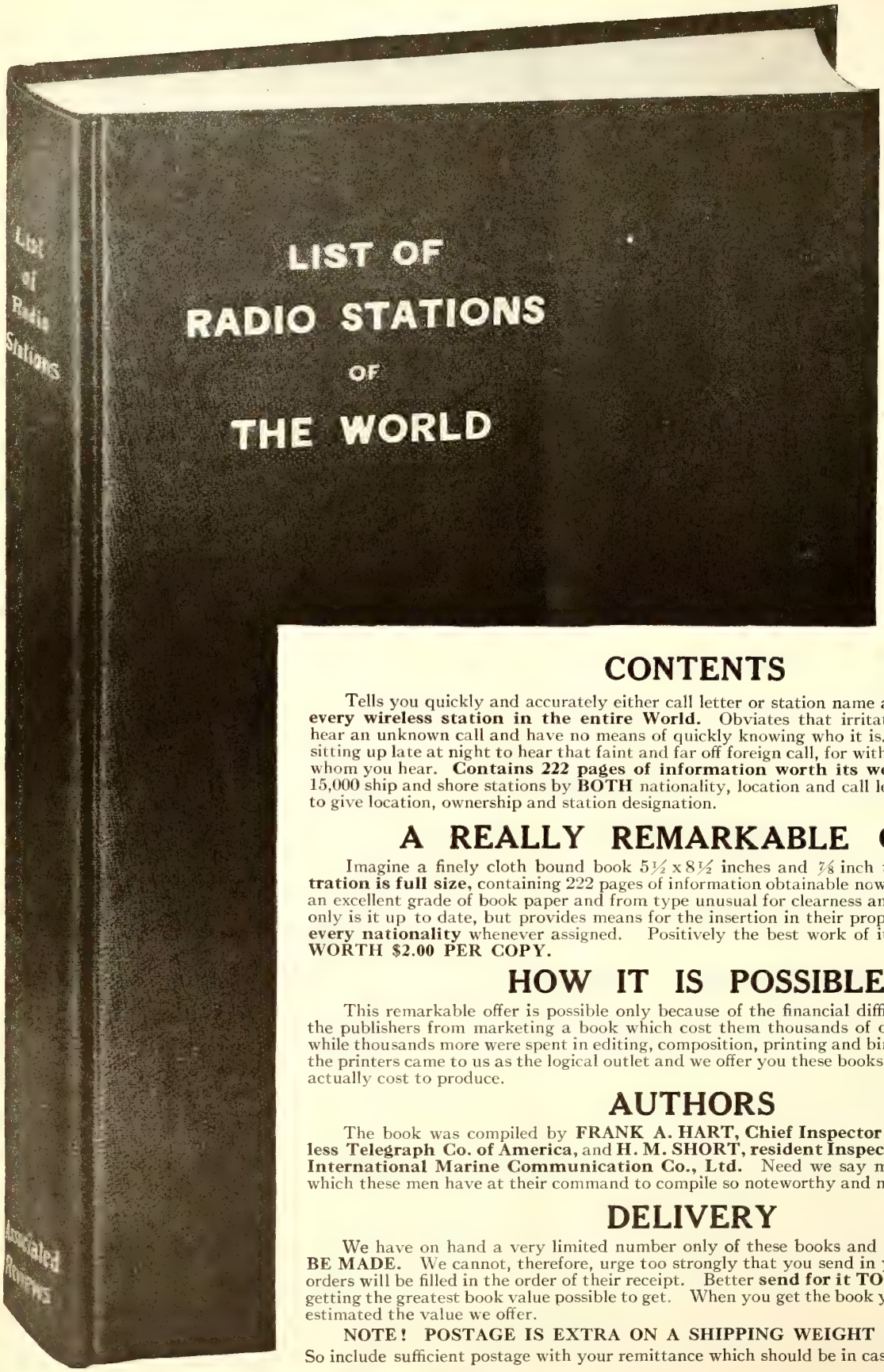
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MARVELS OF MODERN PHYSICS.

(*Continued from page 665.*)

Fig. 3, consisting of two hemispheres connected by a coiled spring on the inside. Now we may consider these hemispheres as uncharged or rather the positive and negative charges exactly balancing each other when they are together. If now the hemispheres are electrically charged in a suitable manner, we may consider the positive as separated from the negative, and the two hemispheres as stretched apart. There is a strain in the ether between these two charges that is analogous here to the tension of the stretched spring.

Take a charged Leyden jar for example. Here we have two opposite charges bound to each other by the strain existing in the intervening medium. The mechanical illustration of this in Fig. 4 is almost self-explanatory. A rope attached to two springs passes over two pulleys. The weighted ends of the rope are the coatings of the Leyden jar, and an excess of weights on one side or the other constitutes the charge. Here the strain between the coatings is shown by the springs again, and if the weights are suddenly evened up, the oscillatory nature of the spark discharge would be aptly illustrated, for the springs would vibrate back and forth "charging" and "discharging" the coatings till equilibrium was reached. Now it is very much a question of whether electricity is a function of the ether or vice versa; that is, whether the electric charge causes the ether-strain or whether the ether-strain causes the charge. One is certainly the accompaniment of the other apparently.

The fact is evident, however, that the ether is a medium for the exertion of forces, either electric or magnetic, and it seems that gravitation is still a third form of ether-strain. Little direct connection is seen yet between it and the other two, but then it must be remembered we know but little of the exact nature of any one of them or even of the "ether." We must content ourselves to live and learn, even though the learning at times seems slow.

[This is the second of a series of papers specially prepared for *The Electrical Experimenter* by Mr. Rusk. Part I appeared in the February issue.—EDITOR.]

A NOVEL RADIO INDUCTIVE TUNER.

(*Continued from page 628.*)

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KILLING THE SMOKE NUISANCE ELECTRICALLY.

(*Continued from page 610.*)

lately in precipitating acid mists, such as are generated in acid producing plants. Figs. 7 and 8 illustrate an experimental outfit for such a purpose. The large circular drum carries a helix of wire which serves the purpose of a ground, while another terminal is placed inside the drum, in the usual way. The connections from the high tension transformer are made to the helical coil and the interior conductor respectively. The pan on which the precipitator is placed is used for collecting the condensed mist which is being generated by the acid making apparata. Fig. 7 shows the precipitator when the current is off, while Fig. 8 depicts same when the current is on. Note the difference between these illustrations.

When will these wonders cease? Electricity cleans our floors, washes our dishes, and now by its power we can filter out the fine solids from smoke without creating a back draft or in the least affecting the operation of the furnaces.

It may be thought that when these smoke precipitators are installed it will cause the firemen to get careless, as a smoking stack is evidence of a badly tended fire, but such is not the case, due no doubt to the inbred pride that all mechanics take in doing their work properly

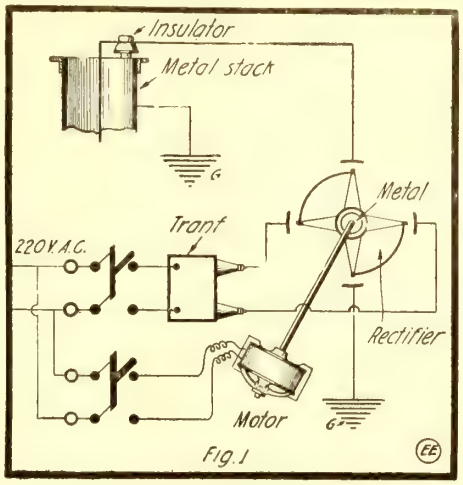


Fig. 1. Diagram of Electrical Smoke Precipitation.

Besides most up-to-date power plants are equipped with recording charts, which register the smoke produced, steam pressure gradient, etc., for every minute of the 24 hours.

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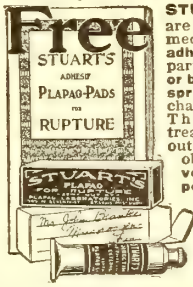
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VIA "SAYVILLE" TO BERLIN.

(Continued from page 630.)

go at night, as the sending conditions are then better. When Germany gets these messages she sends back the letter "R," repeated time after time. This means that she has received the message and understands.

Messages come in to Sayville written in all kinds of languages—English, German, Russian, French, Portuguese. These are translated into English and turned over to the censors, who examine them carefully for hidden meanings before they are put on the tape.

When the Government sends a message to Germany it goes by code. As soon as Secretary of State Lansing has affixed his signature the message is taken by the chief clerk of the State Department to the cipher rooms. The different pages are distributed among the cipher clerks, who begin turning the words into code. After the message has been deciphered it is turned over to another set of clerks, who check it carefully.

The secret code books of the State Department are guarded most carefully. Life is to be expended at any time to defend them. In fact, they are guarded as carefully as the code books of the navy, whose covers are so heavy that when thrown into the sea in case of emergency they will sink instantly.

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FOR SALE — 1½-pint Leyden jar, ½-k.w. zinc spark gap, Leyden jar discharger, books on adventure; everything practically new. For list and prices, write to Robert S. Zimmers, 2822 Broad Ave., Altoona, Pa.

$4.50 TAKES parts of loose coupler advertised in February Popular Science Monthly, page 131, excepting mahogany front, instead of hard rubber. Urban McMiller, 3107 29th Ave., Minneapolis, Minn.

FOR SALE OR EXCHANGE—One orchestra snare drum M sticks and case, drum slightly warped; 1 gas postal card projector, 1 double slide tuner new, 1 pair 2,000-ohm receivers new, one hot-air engine, runs by hot air only; want wireless sending instruments or navy type receiving transformer or loading coil in good condition. Chas. W. Stanfer, 3400 Roanoke Ave., Cleveland, O.

FOR SALE OR EXCHANGE—Type SS dynamo, 20-ohms telegraph set, 3 lbs. antenium wire; want electrical or photo supplies. Edwin Vancor, Morrisville, Vt.

SELL OR EXCHANGE — For Crystaloi AA, $5 American Model Builder, loose coupler, oil color outfit, telegraph set, 80-ohm 'phone, stamp collection and others. What have you? Wm. Manley, Fall River, Mass.

WANTED—A printing press, not smaller than 5x8 inches. J. E. Jones, 203 Mary Ave., Carnegie, Pa.

FOR SALE OR EXCHANGE—Complete wireless receiving outfit with wire, insulators, key, buzzer, etc.; everything necessary; never used; $9; cost $15. Or will exchange for static machine and other good electrical apparatus. Howard Parmele, 1727 Marcus Ave., St. Louis, Mo.

FOR SALE CHEAP—Loading coil, loose coupler, detectors, condensers and helix. Write. Everything new and in perfect condition. L. W. Houlroyd, 34 West 50th St., Bayonne, N. J.

FOR SALE — 2,000-meter receiving transformer, army detector, condenser, aerial switch, Mesco "standard" gap, 1-in. coil, storage battery, "O. K." motor, speed key; reasonable prices. Joseph Maloney, 164 East 82d St., New York City.

FOR SALE OR EXCHANGE—Ives Miniature railway trains, for transformer or 1-in. spark coil. A. Lang, 495 East 164th St., New York City.

FOR SALE—Loose coupler, detector, fixed condenser, Brandes Superior head set, all new and unused; pair rubber boots, Winslow ball-bearing skates, Meccano No. 3, in excellent condition. E. L. Turner, 240 Hart St., Brooklyn, N. Y.

FOR SALE — Brandes Superior head set, 2,000 ohms, $3.50; E. I. Co.'s single head set, 1,000 ohms, $1.75; 1-in. Manhattan coil, excellent condition, $3.50; also other wireless goods. Send for list. Wm. F. McCarter, 4718 N. Camac St., Philadelphia, Pa.

FOR SALE—½-k.w. transformer, electrolytic interrupter, and oscillation transformer, new and in fine condition; will sell cheap for $9.50. Russell Hall, 219 North Ave., Washington, Pa.

FOR SALE OR EXCHANGE—$35 Clapp-Eastman ¼-k.w. transmitting set, $15; Murdock $15 loose coupler, $6; two 43-plate rotary condensers, $2.50 each; high grade, 2,000-ohm head set, $3.75; $5 perikon detector, $2.50; all equal to new. Send stamp for photo and particulars. H. Butterworth, 15 Kosciusko St., Brooklyn, N. Y.

EXPERIMENTAL transformer; 1½-k.w. capacity; will give and take all voltages 1 to 500, new; will exchange for lathe. Johnston, West End, Pittsburgh, Pa.

FOR SALE — 2,500-meter cabinet loose coupler, $10; will exchange for two 43-plate variables, must be new, and audion bulb; 2,000-ohm Brandes head set, $3.50; will pay cash for burnt-out audion bulb; also have other instruments. Write for particulars. H. Underhill, 78 S. Hamilton St., Poughkeepsie, N. Y.

WANTED—High grade manufactured wireless receiving and transmitting apparatus. State lowest price and condition. Crocker Mann, Dover, Mass.

VARIOMETER type tuner, marble base, 60-point switch on primary, 30-point switch on secondary wound with green silk wire, tunes up to over 2,500 meters; first $15 takes it. Chas. W. Mallory, Box 127, Monongahela, Pa.

FOR SALE—Small wireless outfit for $5. Harry Ostness, River Falls, Wis.

WANTED—½-horsepower, air cooled upright gasoline engine, second-hand, without spark coil. State cubic dimensions, weight and price. Wilbur Guenther, Shelby, O.

SELL OR EXCHANGE—Mandelette 1-minute camera, in excellent condition; want 2,000-ohm head set, loose coupler or other wireless instruments. If interested, write. Stephen McIntosh, Meredosia, Ill.

FOR SALE OR EXCHANGE—Large electric train outfit, cost $19; sell for $10; also Mascot tuner, 90c.; Crystal detector, 60c.; would like loose coupler and Brandes Superior 'phones and $3, or Crystaloi type AA and Brandes Superior 'phones and $3 for train. Henry Cole, R. R. 13, Broad Ripple, Ind.

WILL EXCHANGE $5 electric mirroscope, good condition; want pair 2,000-ohm Murdock 'phones with double head band. All letters answered. Frederick Walters, Amityville, N. Y.

FOR SALE—Two 1-k.w. laboratory transformers, never used; in steel cases; 110 to 50 volts; for moving picture arcs or electric furnaces, $7.50; several reels moving picture film, $1.50 each; one 1/16 horsepower Diehl motor, 220-v. A. C., new, $8; will trade. For more information write Gregory Fay, 1024 Bellevue Ave., Syracuse, N. Y.

SALE OR EXCHANGE—No. 3 folding Brownie, complete outfit, two 2¼x3¼ Premos developing tank; films to both; 32 revolver, $5 Waterman pen, Crusader bicycle $20, unused; large amount of 5c. novels, good pair roller skates; want 2,000-mile Electro receiving set; will sell other things. What have you? M. Hendricks, Ingleside, Ill.

FOR SALE — Two-cylinder, 12 horsepower, air-cooled automobile engine, complete with magnets, carbureter crank, $15; Adams Morgan $6 loose coupler, $2; 6-in. water motor, $2. Clarence Vaughan, Middletown, N. Y.

FOR SALE—½-k.w. transmitting set with Packard transformer, Murdock condenser and oscillation transformer, gap and key; worth $30; condition perfect; sell or exchange separately for receiving apparatus. Thomas Hunt, Abingdon, Mass.

WANT National automatic Morse transmitter or an omnigraph cheap, for books and cash, and in good order. J. M. Keating, 8 West Center St., Beacon, N. Y.

FOR SALE—One 2,000-ohm telephone ringer and bells, never used, $1.50; 1 type S. motor, armature needs rewinding, $1.50; 3 lbs. No. 36 enameled wire, $3.50; primary and secondary for Blitzen loose coupler wound with bare wire, never used, $1; 4,000-meter loading coil wound on tube 6 inches diameter and 8 inches long, 50c.; complete parts for Blitzen variable condenser, minus case, never used, $2; 1 dustproof detector case, 7½x13½x4 inches, $1. All the above sent postpaid anywhere in the United States. Edw. C. Schurch, Deer Lodge, Mont.

SELL OR TRADE—38 revolver, belt and holster, $5; 32 revolver, belt and holster, $3; Kodak with portrait attachment, $7; 4x5 camera, $3; 22 special 13-shot rifle, $10; 25 volumes Dumas novels, part leather, $25. All above articles are in excellent condition. Want complete wireless receiving station. Must receive 1,500 to 2,000 miles, or what have you? Inclose stamp for reply. Mr. H. E. Nelfe, LaFarge, Wis.

WILL SELL audion detector and one-step amplifier set for $35; will pay cash for 1-k.w., 25-cycle transformer. Gordon Obersteimer, Station C, Buffalo, N. Y.

BARGAINS—Murdock loose coupler, $4.50; Murdock loading coil, $1.80; Eastman Kodak, No. 1. Jr., $4; all in excellent condition. Wm. Ranft, 4107 Belle Ave., Baltimore, Md.

EXCHANGE — Complete McGraw-Hills Power Plant Library, 8 volumes new, cost $12, for RJ type audion or sanitary rolltop desk. Meade, 975 Putnam Ave., Brooklyn, N. Y.

EXCHANGE—Two-inch Bulldog coil and $5 Mesco adjustable wireless key for RJ type audion. Meade, 975 Putnam Ave., Brooklyn, N. Y.

MIGNON cabinet R. L. C., 3 special 10,000 meters, including 3,000-ohm telephones; sacrifice for $29; excellent condition. F. B. Meeker, 1632 University Ave., New York.

HAVE one new Premo Junior Kodak, 2¼x3¼; 1 type S dynamo; would like to exchange for water motor, not less than six inches. Thomas Alsobrook, Hosford, Fla.

RECEIVING set (loose coupler, two variables, one fixed condenser, loader, perikon detector) mounted in cabinet, tunes 4,000 meters; $12, $12.50; Winchester 20-shot, 22 rifle, good condition, $7, or exchange for equal value; variometer, $1; want gooseneck audion socket, Murdock loader, variables. Francis Pray, 102 Heath St., Somerville, Mass.

FOR SALE—Complete wireless transmitting and receiving sets, including ¼-k.w. Thordarson transformer, rotary spark gap, Bunnell brass key, oscillation transformer, 2 sections Murdock condensers, 2 Leyden jars, kick-back preventers, lightning switch, loose coupler, Murdock variable condenser, E. I. Co.'s fixed and variable condensers, Ferron and Crystal detectors, Brandes Trans-Atlantic type 'phones; in same condition as when bought, cost $82.50. Make an offer or send stamp for photo. B. D. Arata, 5154 Cates, St. Louis, Mo.

SALE OR TRADE—One $5 medical battery, 2 telephone induction coils, 1 22-cal. rifle, 1 pair ice skates, 30 25c. books, etc. Send for complete list. A. Edington, 424 Butler St., Ft. Wayne, Ind.

WANTED—One double pole, 1,000-ohm receiver, head band and cord; have gum boots, size 5½, worn twice, fine condition; 1 pair new $2 ice skates. Write H. F. Happoldt, 2743 Germantown Ave., Philadelphia, Pa.

WANT ½-k.w. wireless transformer (used E. I. Co.'s preferred), also high frequency adjustable condenser; will pay cash. C. Ehrenberger, First National Bank, Chicago, Ill.

SWAP—One Bunnell giant sounder, new; 1 Little Hustler motor, almost new; 1 4-in. horseshoe magnet, for 1-in. Bulldog spark coil in good condition. E. Servan, Lumberton, N. J.

HAVE violin, accordeon, flashlight, harmonica, books, chemical laboratory supplies with chemicals never used; will trade for receiving and sending station, must receive at least 1,500 miles at night and send 10 miles. What have you? Write for description. Articles all in excellent condition. Address J. G. Schroeder, Box 31, Wisner, Neb.

A BIG BARGAIN—Will give a $4 horn free with a Smith motor wheel for $40; no trades. Arthur Sager, 941 Superior St., Appleton, Wis.

FOR SALE—$6 Meccano set in good condition with $1 worth extra parts. F. Crapser, 418 Jamaica Ave., Brooklyn, N. Y.

WANTED—¼ or ½ k.w. transformer; have for exchange mandolin, stamp collection $20, spark coil, hikemeter, Stevens 22, books, small typewriter. All letters answered. Adelmer Bryon, Ridgefield, Conn.

EXCHANGE—Xylophone, two octaves chromatic scale for "Edison" cylinder machine with recorder; trade motorcycle for glider or motion picture camera. Robert Bullock, York, Neb.

HAVE number of 2-point rubber base switches, new detachable key; bargains; 25c. each. John Means, 44 Zachary St., Atlanta, Ga.

EXCHANGE — 1/10 horsepower speedy, variable speed General Electric motor, almost new; would like rotary variables, or what have you? Zadig, 33 Vernon Ave., Long Island City, New York.

I HAVE 30-in., 8 plate Waite & Bartlett static machine, full set of electrodes, X-ray attachment with tube; no use for same. No reasonable offer refused. All letters answered. Make offer, money or exchange. Harry P. Noll, 1000 Packer, Williamsport, Pa.

FOR SALE OR EXCHANGE—One small receiving set, 1 four-forty storage battery, 1 large 2,500-meter cabinet receiving set. Write or call. C. E. Littlefield, 2672 Mansfield Place, Sheepshead Bay, New York.

FOR SALE OR EXCHANGE—Electric train, engine, three cars, 16 sections of track and one pair of switches, cost $9 when new; will sell for $5, or what have you electrical? Clarence Paulus, Kampmeier St., Burlington, Ia.

FOR SALE OR EXCHANGE—½-k.w. sending set, Boston key, etc.; Blitzen receiving cabinet set (new), and Brandes 'phones, cost $33; audion with X grade bulb and batteries (60 volts), for ½-k.w. Hightone set, or what have you? Frank Marshall, 517 W. Delaware, Toledo, O.

I WANT a static machine, omnigraph, 8 to 12-in. spark coil, storage batteries 6 to 10 volts, 60 to 100 amperes, hot wire ammeter, Tesla coil, fluoroscope, tape register, coherer, electrolytic interrupter, antenna switch, dynamo, or generator (10 to 50 volts), Red Devil water motor, rotary gap, pole-changing switch, galvanometer, 110-volt meter and ammeter, ½-k.w. transformer, with oil condenser and helix. I will pay cash for these articles or will trade. What do you want? R. W. Williams, 826 First Place, Plainfield, N. J.

FOR SALE OR EXCHANGE—2,500-meter loose coupler, D. C. motor, and other items. Send for list and pictures. Want variable condensers and offers. J. W. Kidd, Niles, O.

HAVE telegraph, $1; long distance telephone receiver and cord, 75c.; two 1-foot rods and sliders, 50c.; all for $2, or trade for wireless instruments. C. Fitch, Dalton, Mass.

FOR SALE CHEAP—Complete, new seven-piece wireless receiving set, with large aerial; made by Electro Importing Co. Albert Grant, Toms River, N. J.

FOR SALE—Several hundred copies of "Golden Hours" and "Golden Days." Send stamp for lists and prices. Samuel Olnhausen, 824 Chester Ave., East Liverpool, O.

FOR SALE OR EXCHANGE—Complete sending and receiving set, cost $100; sell $40, or exchange for Victrola. Frederick Gittelbauer, East Rutherford, N. J.

EXCHANGE—Pair of Winslow's hockey skates, clamp, cost $3; wan 100 amp. lightning switch. W. N. Curry, Sweet Springs, Mo.

FOR SALE—Two 2,500-meter, navy type loose couplers, $10 each; one ¼-kilowatt oscillation transformer, $1.50; and a 6-volt Knapp motor, stands 5 inches high, $1. Henry Forbes, 3532 Eleventh Ave. So., Minneapolis, Minn.

EXCHANGE—Six-inch bench lathe, chuck, slide rest, 80-watt dynamo, 6-v. battery charger, 2-horsepower Indian engine; want rolltop desk, Ford Master vibrator for SS dynamo, Remy magneto and coil 2-cylinder, $12; Briggs 4-cylinder and coil, $8; 4x5 box camera, $2; 2-horsepower dynamo castings (rough), $10. Inclose stamp for description. G. F. Silliman, Sardinia, N. Y.

FOR SALE OR EXCHANGE—Westinghouse rectifier, A. C. 110-volt, D. C. 25-volt, 10-ampere; good condition; $35, or will take audion detector as part in exchange. J. H. Wildt, 614 N. Lombardy St., Richmond, Va.

FOR SALE OR TRADE—One pedometer Columbia bicycle lamp, small mechanical drawing set, tie pin for flashlight, fountain pen flashlight, potentiometer; all in good condition; want X-ray bulb, variable condenser, Crystaloi detector. All letters answered. Francis Crump, Jr., Columbus, Ind.

SALE OR EXCHANGE—22 Stevens rifle, $3; long telescope, $2; water motor, $2; wire telegraph set, 75c.; parts of telephone, $2; parts 1-in. spark coil, $1.75; revolver, nickel, fountain pen, flashlights, 50c. each; silicon detector, rotary disc, ear cushions, 75c. each; want transformer coil, Edelman's "Experimental Wireless" and "Experiments," variables, parts of navy receiving transformer, burnt or broken audion bulb. L. Mason, Alden, Minn.

FOR SALE OR EXCHANGE—Several A. C. and one D. C. arc lamp; will sell or exchange. Burgess Stewart, 222 Main St., Huntington, W. Va.

I HAVE many things to sell or exchange. Write for list now. All letters answered at once. George Sharp, 73 Everett Ave., Providence, R. I.

HAVE single and 16-shot 22 rifles, portable drilling machines, coasterbrake bicycle, 4½-horsepower engine, clutch transmission gearing, all gears for attaching to buggy. Write for description. Want motorcycle or cash. H. Reagan, Box 95, McBrides, Mich.

FOR SALE—1A Premo camera (2½x4¼), $2, cost $3; Type SS dynamo, $2; 22 rifle, Winchester, $2; film pack tank, $1, A1 condition. L. A. Madison, Kingman, Me.

FOUR-STRAP switchboard to exchange for spark coil; also have telegraph sounder and 150-ohm relay. H. Lince, Allegan, Mich.

FOR SALE OR EXCHANGE—3A Eastman Kodak in case fitted with Ziess Tessar IIB lens, multispeed shutter, 1 sec. to 1/500th, plate adapter, 2 new plate holders, case 6 extra lenses, 4-section telescope tripod, cost $100.80; also Gibson mandolin almost new, "flat," in black leather case, cost $57.50. No reasonable offers refused. G. H. Dodson, 200 Sylvan Ave., Leonia, N. J.

WIRELESS receiving set, comprising a single slide tuner, new silicon detector, condenser and 75-ohm receiver, $4. Elmer Baier, 444 Seventh Ave., Brooklyn, N. Y.

WANTED—Six Murdock molded condensers. Write telling how many you have and what you want. Have two quenched gaps, etc., or will pay. R. D. Zucker, 46 Clinton Place, Mt. Vernon, N. Y.

EXCHANGE new $115 audion receiving set for twin motorcycle, 1913 model or later. Must be in first class condition. Photo sent to interested parties, also loose coupler for 'phones or hot wire meter. Wm. Lohr, 592 Miller Ave., Columbus, O.

FOR SALE—Complete I. C. S. Reference Library sets of the Structural Engineering, Gas Engines, Surveying and Mapping, and Spanish Language courses. Italian home study outfit. Text books on shorthand, typewriting, mechanical and architectural drawing, foreign languages, etc. Colt 32-cal. automatic pistol and 38-cal. police positive special revolver. No. 2 Bull's-Eye kodak. Several sets drawing instruments, scales, protractors, slide rule, etc. Mandolin, metronome, music stand and satchel. Pope twin motorcycle. No. 5 L. C. Smith typewriter. No exchanges. Write for description of articles interested in and prices. Eugene Lewis, Haley Road, Kittery Depot, Me.

FOR SALE—W. B. Duck's Code Learner, 90c.; U. S. S. detector, $3; one year Boys' Magazine, 75c.; 29 Modern Electrics and World's Advance, $2.90; 8-inch permanent audion magnet, 60c. T. Waldie, Jr., 21 Woodbury St., Beverly, Mass.

EXCHANGE—Shotgun, rubber shoes, bracelet, 6-v. motor, fishing rod, Hampton watch works, razor, books; want violin, protectograph, coil, most anything. Write. Box 322, Glasgow, Mo.

1,000 WATT nitrogen light, good condition; will exchange for 6-60 storage battery or one inch spark coil and voltmeter or ammeter. Albert Ivenmey, 1852 E. 75th, Kansas City, Mo.

CASH paid for audion bulbs. Apply E. W. Farmer, Box 403, Farnham, Quebec. Correspondence answered.

HAVE Type S dynamo, polishing head and telegraph instruments, will trade for good receivers or Type AA crystaloi, or what? Other articles for trade. Fred E. Egan, Missouri Valley, Ia.

FOR SALE CHEAP—Wireless receiving set, consisting of double slide tuner, silicon detector, two condensers, buzzer test with key and one No. 3 1,500-ohm receiver; all new; first $5 takes set. L. J. Knittel, 53 Wilkins St., Rochester, N. Y.

WANTED—Audion bulbs, burnt coil or good; variable condensers, few pounds No. 30 silk insulated copper wire for cash. All letters answered. Wm. Bohn, 1515 Second Ave., New York City.

WILL exchange a new 825 Belz Tesla coil for a 12-ga. Winchester or Remington pump gun, equal value in Murdock, sending condenser, audion detector or amplifier, stranded bronze wire, or $10 cash. John B. Hawley, Jr., 912 College Ave., Ft. Worth, Tex.

FOR SALE—Blitzen receiving cabinet set; hand bench punch, weight 150 lbs.; metal splitting shear, weight 100 lbs. Write for particulars. C. F. Lee, 1417 Belleplain Ave., Chicago.

FOR SALE—Four galena detectors, 30c. each; postage extra. Clinton Stanley, 153 Mariner St., Buffalo, N. Y.

LOOK!—A bargain. Complete navy type loose coupler receiving outfit; mounted on cabinet type base, mahogany finish throughout; uses switches for all tuning, also has dead end switch and detector shunt; very accurate tuning possible; price only $10. George W. Hansen, Carney Ave., Marinette, Wis.

FOR SALE—Complete two-kilowatt transmitting outfit for $55; operates on 110 volts, 60 cycles, alternating current; consisting of transformer, condenser, helix, spark gap and 10-ampere hot wire meter. Or will sell instruments separately as follows: Two-kilowatt transformer, $25; 14 copper-plated Leyden jars in case, $30; helix with spark gap inside, $6. Everything in first class working condition. Are you a bargain hunter? Here is your chance. Write to-day. Sidney Friedrich, 350 East Commerce St., San Antonio, Tex.

FOR SALE—An E. I. Co. 8-volt, 10-ampere dynamo; new and slightly used; will sell for $5.50. Winston Coleman, R. R. 7, Lexington, Ky.

EXCHANGE—Rep. rifle, watch, coil, 2,000-ohm 'phones, Elec. and Mech.'s from 1906 to 1913; want "Amateur Work" magazines; can pay cash. Harold E. Hickey, 1435 Howard St., Philadelphia, Pa.

FOR SALE OR EXCHANGE—Single barrel shotgun, No. 12, value $6; 2,000-ohm double head set, value $5, for a 1½-in. transmitting and loose coupler receiving set, or what? Harry Thomas, Mound City, Mo.

BARGAIN for $5—½-in. spark coil, 1 Gernsback gravity relay, 1 zinc spark gap, 1 coherer and decoherer and 1 strap key, all E. I. Co.'s make, cost $7. Waldo C. Buck, Britton, S. D.

FOR SALE—Gasoline engine with stand, coil and gas mixer. Write for photo and particulars. Irvin Weaver, 1637 Xenia Ave., Dayton, O.

WANTED—To buy or trade wireless goods or Meade bicycle for complete electric lighting outfit for small house, small gasoline, kerosene or motorcycle engine. L. Fulton, Muses Bottom, W. Va.

SELL or exchange 2x2-in. vertical, one-cylinder, air cooled gasoline engine; has new piston, cylinder, coil and carbureter. Fisher Ames, Massena Springs, N. Y.

TO TRADE for good long-distance time receiving set, Mark Stern mandolin with case, small brass upright microscope and Mandel one-minute baby postcard camera. All inquiries answered. Robert Bray, Big Timber, Mont.

FOR SALE—Lathe, water motor, and several wireless instruments; cheap. Call evenings or write. H. A. Gilman, 156 Jerome St., Brooklyn, N. Y.

FOR SALE CHEAP—1½-in. coil, new 6-cup detector, tested mineral, piano finish base, gets long distance; at half price; guaranteed satisfactory. Write D. M. Danvers, 1109 N. Francis, Oklahoma City, Okla.

HAVE two watt meters, one folding vest pocket camera, one box camera, 2A Brownie; want pair wireless receivers, 3,000 ohms; must be in good condition. What have you? Lowery Simmons, Van Alstyne, Tex.

FOR SALE OR EXCHANGE—(E. I. Co. goods: Transatlantic 'phones, rotary and fixed condenser) 5-disc omnigraph, Duck's Ferron detector, large home-made loose coupler and spark coil, helix, key; 5 volumes Musical Educator. Would consider I. C. S. steam engineering volumes, engineers or mechanics' tools. John Methven, Box 171, Ronald, Wash.

FOR SALE—$4 Massie wireless key, or will exchange for Brandes Superior receivers; will pay extra. Emmet Faacks, 413 Fourth Ave. S., Minneapolis, Minn.

ANXIOUS to get and will pay cash for bound volumes 1 and 2 of "The Electrical Experimenter." James Donahue, 857 Vernon Park Pl., Chicago, Ill.

FOR SALE—Electro goods in fine condition. Galena detector, opal glass base, 95c.; 2,000-ohm Junior wireless 'phones, $2.90; 5,000-wave meter loading coil, $1.90; zinc spark gap, 30c.; telegraph key, 25c.; Junior tuner, $1.60; Junior fixed condenser, 40c.; one-inch Bulldog spark coil, $3.25; sold separately, or all for $11. Ralph Thompson, Wooster, O.

WILL TRADE an E. I. static machine for a small variable condenser. H. W. Reichle, 550 Seventh Ave., Pittsburgh, Pa.

FOR SALE—$6 Radio Equipment Co. loose coupler brand-new, tunes 2,000 meters, $4.50. MacDonald, 36 East Tulpehocken St., Philadelphia, Pa.

SWAP — Brand-new Eastman's 3A Postcard Brownie camera for about 2,500-mile range wireless receiving set. E. Haugerud, Scappoose, Oreg.

FOR SALE—New 1,000-ohm single receiver, $1.50; first class sounder and key, $1; Marlin 22-cal. repeater, fair order, $4. Sidney Cook, Victoria, Ill.

FOR SALE—Wireless which receives 2,500 miles; first $10 takes it; also a half-inch coil, $1. Kenneth L. Jennings, Mattapan, Mass.

AUDION detector and one-step amplifier combination, $35; complete ¼-k.w. transmitting set has rotary gap; Blitzen transformer, etc., $22.50; other apparatus. L. Gebhard, 1127 Ellicott St., Buffalo, N. Y.

FOR SALE—Practically new wireless instruments; Blitzen, De Forest, and other reliable makes; also books and magazines. Write. Withers Gavin, Corinth, Miss.

FOR SALE—2,500-meter loose coupler, 1-in. spark coil, detector, spark gap, key, switches and parts for a cabinet set. Inquire of Karl Haberstick, 74 14th St., Wheeling, W. Va.

HAVE brand-new Scout No. 2A with printing and developing outfit, cost $6; will exchange for E. I. Co. 1-in. spark coil, Bulldog type. J. Howard Kelley, Franklin, N. H.

FOR SALE—Loose coupler, $1.50; 22 rifle, $1.50; violin, $2.50; $5 football, $2; ½-in. coil without vibrator, $1; two 1,000-ohm receivers, $1.25 cash. John W. Carroll, McComb, Miss.

FOR EXCHANGE—A Colby receiving transformer, tunes 5,000 meters, and a 1½ coil for a National automatic telegraph transmitter with records, without key or sounder. Frank Spencer, 289 State St., Auburn, N. Y.

BARGAIN—E. I. Co. electrolytic detector and rheostat, $1.25; good condition. L. Loase, 4704 Park Ave., Bronx, New York City.

FOR SALE—Electro potentiometer, 95c.; electrolytic detector, 85c.; single slide tuner, $1.25; Mesco double slide, $2.50; mineral detector, $2.75. Vincent Natalish, Jr., 68 West 56th St., New York.

FOR SALE—Receiving outfit, receives 2,000 miles; will receive time from Arlington. Make offer. John Fouhy, 1428 Blue Hill Ave., Mattapan, Mass.

BIG SNAP—One Ives Electric train; practically new, 3 pieces, 8 straight track, 8 curved, value $5.75; want $3. H. Ananiantz, 700 W. Washington St., Los Angeles, Cal.

FOR SALE OR EXCHANGE—A 6-v. 6A dynamo motor that cost $12.80; three 2-volt, storage batteries, never used, $2 a piece, and 6 different-sized flashlights without batteries. Kenneth Jennings, Mattapan, Mass.

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FOR SALE—Electro Importing Co. instruments, used one week. Loading coil, lead peroxide detector, potentiometer, 50-ohm relay, half-inch spark coil, small spark gap. Write for bargain prices. C. Alleman, 1408 Madison St., La Crosse, Wis.

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FOR SALE—Sending outfit, consisting of a 2¼-in. coil, navy gap three, condensers, key, and storage battery of 8 volts, 80 amp. hours, for $18; or sold separately. Fred Carlotte, 78 Christopher St., New York, N. Y.

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I HAVE for sale or exchange 2,000-ohm Brandes 'phone, qt. Leyden jar, $7.50 loose coupler, typewriter Rem. No. 6 in A1 condition, 2-cylinder gasoline engine, 14-horsepower, air cooled, in good running shape, 12-gauge Remington shot gun, pump action, hammerless, as good as new, numerous electrical and mechanical books. All the above is in practical, A1 condition. I will trade for anything electrical or mechanical, or sell very cheap. Don't hesitate to write me, for I have some bargains. I had rather sell the above articles. E. A. Hahn, McNary, Ky.

FOR SALE OR EXCHANGE—One complete sending and receiving wireless set with 2,000-ohm 'phones; will sell at a sacrifice. For full particulars write me. Would also like to buy or swap accessories for O Gauge Electric trains. George Adams, 601 North College, Charlotte, N. C.

MUST SELL—Circumstances force me to sell my ½-k.w. Packard; used two months; $8.50 brings it prepaid. L. A. Walker, 1716 South 20th St., St. Joseph, Mo.

HAVE Excelsior printing press with outfit, camera outfit, Roller organ, postcard projector, wireless apparatus. What have you? Nathaniel Leek, Amagansett, N. Y.

FOR SALE—Brandes Superior 'phones. One 'phone and head band new. Other 'phone in good condition, $3. Arnold's special make loose coupler, primary 12-in. long, fine instrument; can be used three different ways, $7; Murdock $3 variable, $1.50; large cabinet, good mahogany finish; has two tap switches and taps also test detector, $1.50; complete set for $10.65. Edwin Cohan, 601 West 156th St., New York.

FOR SALE—Two tuners, value $7.50; sell for $3.50, or $2 each; $5 Ferron detector, $2.50; $5 Murdock variable condenser, $3; $3 aerial switch, $1.50; $9 cash for whole outfit. All bought new and in good condition. Ellsworth Davis, Morrice, Mich.

WANTED—Second-hand dynamo cheap (110 v., about 10 amp.) or smaller machine; send description. Clarence L. Robinson (Curtis Rte.), Waynesville, Mo.

HAVE telegraph set, step-down transformer, 110 A. C. to 8 D. C., and drawing set; want 2,000-ohm head set. Write. Stephen Kent, 92 Campbell St., Pawtucket, R. I.

FOR SALE—No. 3 Brownie camera in excellent condition with portrait attachment for same; developing and printing outfit with instructions. All for $7. Write. Walter Curnutte, Rivesville, W. Va.

MOTOR WHEEL WANTED—Have up-to-date receiving outfit, complete in every way, including audion, Blitzen variable, Brandes 'phones, commercial loose coupler, etc., 1-k.w. quick-throw aerial switch and 600-volt lightning switch also included; want to exchange for Smith motor wheel in good condition. All inquiries will be answered. Edward J. French, Peekskill, N. Y.

HAVE $12 mail-order course, $5 stamp collection, $3 "Solid Receiver"; want good receiving set, or other wireless instruments. Mort Calcott, East Liverpool, O.

FOR EXCHANGE—Cameras 5x7 Century outfit, 3A Eastman Kodak, Premo Filmplate outfit, pair prism binocular field glasses, a $20 electric postcard projector, Savage automatic self-loading rifle, 22-cal.; two hammerless revolvers, tools, etc.; want electrical goods, open core transformer, or 1-k.w. closed core, a Tesla coil, or what have you? Odell, Optometrist, Fremont, Mich.

FOR SALE OR EXCHANGE—Experimental laboratory equipment consisting of volt meters, galvanometers, Wheatstone bridges, and other electrical instruments, together with large quantity of telephone relays, drops, jacks, transmitters, receivers, magnet wire, granular carbon, carbon electrodes, chemicals, small dynamo, lathe, drill press, filing cabinets and other equipment. State what you want. H. R. Van Deventer, Box 591, Sumter, S. C.

FOR SALE CHEAP—Complete amateur station, sending and receiving set, and large aerial; will sell for $15; worth twice as much. If interested, write. Ed. Guilmette, 343 Mason St., Woonsocket, R. I.

FOR SALE OR EXCHANGE—Complete volumes of Popular Electric magazines, Nos. 2, 3, 4, 5, 6; make reasonable offer; all ready for binding. William Kirsch, 782 Bergen St., Newark, N. J.

POWERFUL 11-in. water motor, $4.25; $15 Erector outfit with $3 motor, $8; 22 rifle, $1.75, cost $4.50; will exchange for audion bulb, 3,000-ohm 'phones, Multi-Audi-Fone and aerial. Archie King, North St., LeRoy, N. Y.

COMPLETE "Talking Head" for the construction of a telegraphone, will be exchanged for any of the following instruments: A hot wire ammeter, Weston or Keystone voltmeter, small dynamo, opera glasses, variable condenser, or what have you? Samuel Cohen, 1936 Pitkin Ave., Brooklyn, N. Y.

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BRAZING TORCHES, 40c., postpaid; will heat one inch bar red hot in three minutes. Send stamps or money order. Auto. Welding & Mfg. Co., Omaha, Neb.

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MISCELLANEOUS

DRAWINGS made for inventors. Consulting Engineer, EE-3240 Seminary Ave., Chicago.

BEFORE you try to wind secondaries for a coil or transformer get our prices; we can save you time and money. State your wants plainly. Eureka Secondary Co., 6937 S. May St., Chicago, Ill.

THERE is but one telegraph school that places all grades direct in the railway telegraph service. It is Pelnars, Madison, Wis.

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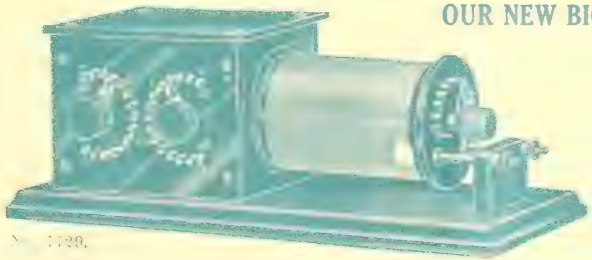
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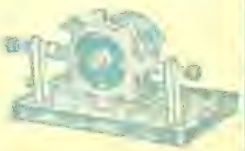
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THE ELECTRICAL EXPERIMENTER

H. GERNSBACK EDITOR
H. W. SECOR ASSOCIATE EDITOR

Vol. III. Whole No. 36 APRIL, 1916 Number 12

How the Blind May Read by Sound

By Professor F. C. Brown

THE Phonopticon is an instrument that translates the varying light composites, particularly those of the printed page, into characteristic sound composites. The illumination from the printed page varies in intensity, form and sequence. The inventor of this valuable scientific device set out to translate this varying character of light, through electrical means, into sound impressions varying in pitch, intensity and sequence.

The only fundamental difficulty to be overcome was that of the production of some very light-sensitive agent which could be used in small size units. It was required that this agent should instantly change its electrical resistance whenever the light intensity varied. The ordinary selenium cells, where the amorphous selenium was crystallized in mass aggregates, were hardly satisfactory for three reasons. They were first of all insufficiently sensitive, were necessarily too large to properly discriminate printed letters and they lacked the stability and uniformity required. The inventor had the problem of the aural interpretation of the printed page through mechanical means casually in mind for three years before he succeeded in obtaining the specially sensitive crystals to do what the rods and cones do for the human eye.

Finally he succeeded in producing isolated crystals of selenium, such as are shown in Fig. 1, which were large enough to be placed in separate electrical currents and which were small enough to receive the impression from a fractional part of the smallest ordinary print. The crystals were grown by special means of sublimation of the vapor of selenium, some of the most sensitive varieties requiring months for formation. In Fig. 1 A represents selenium crystals of the monoclinic system, B hexagonal crystals and C some interesting growths of crystals of selenium. These crystals further were found to be stable and extremely sensitive to light. They are more than a hundred times more sensitive than the most sensitive standard selenium cell. One of the crystals will, with a sensitive galvanometer, respond to a light only *three-millionths* as intense as the most sensitive thermopile. Experiment shows that with one of these crystals and a 24-inch telescope *it is possible to detect the presence of a 16-cp. carbon lamp at a distance of more than 1,000 miles.*



Marvelously Light-Sensitive Electrical Device Perfected by Prof. Brown by Which Blind People May Read by Sound.

Thus these crystals in the phonopticon correspond in function and sensitiveness to the rods and cones of the human eye. The electric currents that pass through the crystals correspond to the nervous impulses that pass in the optic nerves. It might some day be possible, in certain cases of blindness, to connect these varying electric currents directly to the optic nerves and thereby get stimula similar to ordinary light stimula. However, the inventor chose a much easier road to the brain centers of the blind. He elected to transform these varying electric currents into corresponding varying sound characters and thereby *let the blind see by hearing.* The arrangement of the electric circuits and the selenium crystals is shown in a conventional way in Fig. 2. The crystals are placed in combination Wheatstone bridge circuits. The light from the white page 6 is focused on a line of crystals 1 by a lens 5. The blind reader adjusts a sliding resistance 8 for each crystal until there is no sound heard. He can ascertain the currents from each crystal by the frequency of interruption of the current, i. e., by the pitch associated with each.

The printed letters are illuminated successively by a narrow ray of intense light which travels across the page. The image from the lens acts upon a parallel group of crystals, which control different frequencies

DID you ever stop to realize how many thousands of the soldiers now battling for their lives in Europe's tragic catastrophe will return home blinded for the rest of their lives? Besides there are many thousand blind in our own country. To all these unfortunates there seems to be a new hope held forth, for by properly combining selenium and electricity Professor Brown has seemingly solved the problem of how the blind shall see, even though their eyes be closed. Would this invention not be well adapted to curtail eye-strain for those who have perfect vision?

in the telephone receivers. The interrupters (18, 18, 18), in series with each crystal, give a different distinct pitch for each crystal affected.

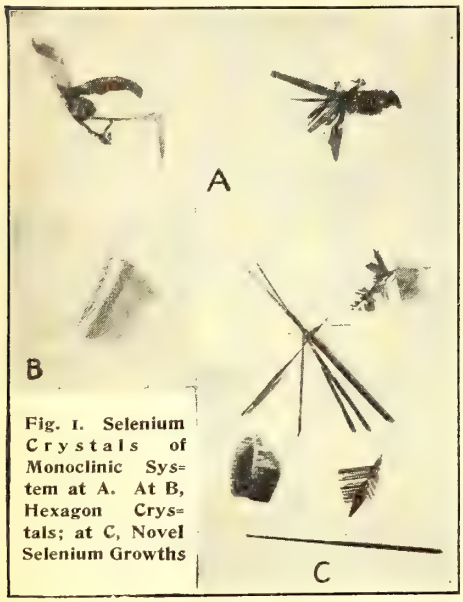


Fig. 1. Selenium Crystals of Monoclinic System at A. At B, Hexagon Crystals; at C, Novel Selenium Growths

These electrical impulses, thus controlled, are converted into sound waves of a specific pitch or note by a resonator provided in each telephonic receiver. Three receivers are here used, their number corresponding to the number of crystals employed, which may vary from one to four. So that three receivers may be used at one time, there is incorporated in one receiver shell two resonator and diaphragm mechanisms, as seen in Fig. 3. Thus each "part" of a printed letter affects a certain crystal, and through it upon a separate interrupter and resonator (receiver). As the successive parts of a letter enter the lighted field before the lens (and crystals), the changes resultant are simultaneously manifested by a change in the pitch of the note.

When the little box containing the lens and the crystals is moved over the page a series of notes are heard in varying sequence, loudness and rapidity. The blind person soon learns the combination of notes and intensities produced by each letter and, in fact, by each word. One blind person was able after 20 minutes' practise to illustrate on the pipe organ the alphabet of the phonopticon.

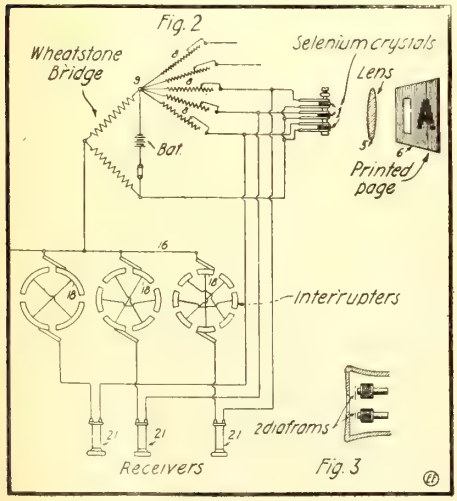


Diagram of Apparatus Enabling Blind to Read Electrically.

Electro Ray Projector, a Movie Concoction

Pearl White, "Pathé's Peerless Pearl," as she is called, still works her magic on the motion picture fans, and is undoubtedly the most popular little lady that has come to gladden the screen since—well, since she was last seen as the ebullient Elaine in company with Edwin Arden as the wicked Wu Fang, and Arnold Daly as the clever Craig Kennedy. She is still beautiful, blonde and beatific, and just the sort of person romantic things couldn't help happening to.

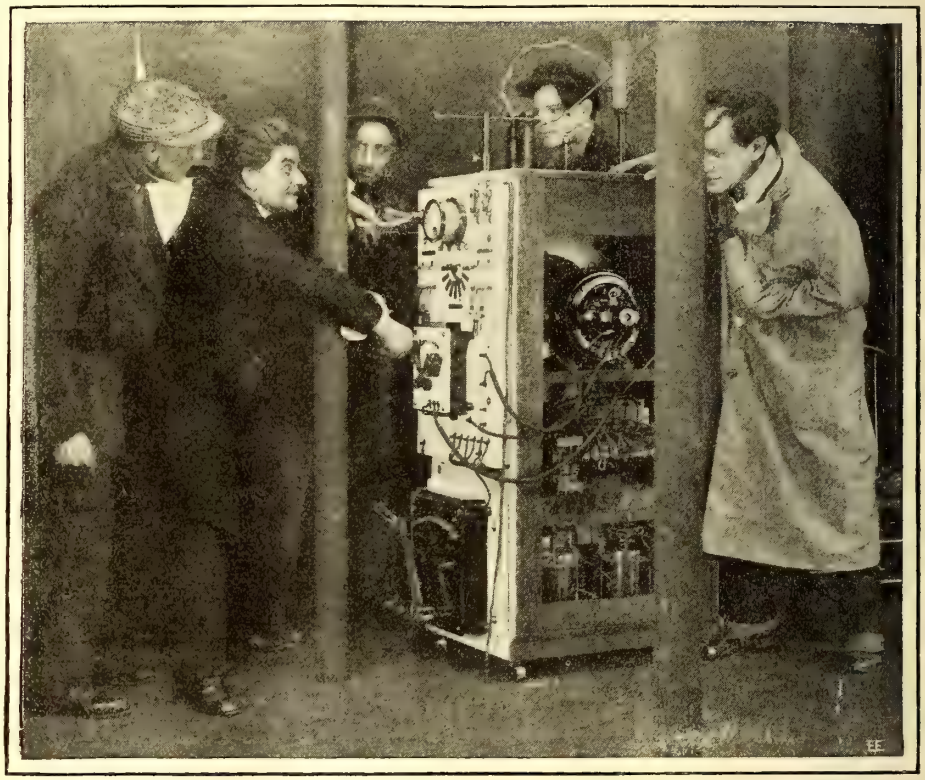
After being rescued by that mysterious avenger of wrongs, known to the underworld as "The Laughing Mask," and returned to the father she was kidnapped from when a child, she is again threatened by the sinister master criminal Legar, alias "The Iron Claw." Legar's purpose is to wreak vengeance on Enoch Golden, the girl's father, who, years before, finding Legar, then his friend, unfaithful, had the latter's face seared with white hot irons and his hand crushed in a vise.

To intimidate Golden into returning his daughter to his (Legar's) clutches, the master criminal with the help of Stein's "Electro Ray Projector," a deadly instrument, sets fire to many of Golden's properties and threatens further mischief should his demands not be acceded to. Marjorie, the daughter, seeing that she is the cause of great misfortune to her father, voluntarily returns to "The Iron Claw."

But, by the looks of the thing, Legar won't have such easy sailing, for Davy Manly, Golden's secretary, has her interests at heart, and that other mysterious agent, "The Laughing Mask," promises to give further account of himself in the next chapter called "The Cognac Cask."

ELECTRIC 'BUSES IN ARABIA.

It is proposed to replace the horse-drawn carriages at Aden, Arabia, with 'buses using electric batteries. A 'bus that will carry six or seven passengers at a regular fare of about 12 cents from Steamer Point to Crater, about 5 miles, is expected to wrest all the business from the old-time pony carriages. The electric type is favored because of the high price of 36 cents a gallon for gasoline.



A "Thriller" from the Movies, When the Villain Demonstrates His Electro Ray Projector.

CONGRESS INTERESTED IN RADIO TORPEDO.

Wireless control from an aeroplane of a coast-defense torpedo has been perfected, it was learned recently, and patents are included in the Hammond radio-controlled torpedo rights, for the purchase of which the Navy Department has asked Congress to appropriate nearly a million dollars.

Aeroplane control, navy officers explain, makes it possible for the operator to guide the radio torpedo through the water from any height, air bubbles from the compressed air motor of the torpedo giving him a certain guide by which to steer it against a ship's hull. By use of powerful glasses it has been possible heretofore to control the torpedo from shore to a distance of nearly 10,000 yards, but the aeroplane device now will make the missile effective to the full range of its motor capacity, or even far at sea if the torpedo is launched from a swift motor boat within sight of an enemy ship.

WHAT 1 CENT OF ELECTRICITY WILL DO.

Operate sewing machine two hours.
Keep six-pound iron hot 15 minutes.
Heat electric curling iron 14 times.
Percolate four cups of coffee.
Lift 100 gallons of water 100 feet.
Give light of 75 candles for one hour.
Toast bread for six persons.
Operate luminous radiator for eight minutes.
Warm baby's bottle twice.
Cook Welsh rarebit in chafing dish.
Keep heating pad hot two hours.
Heat 8-inch electric stove eight minutes.
Operate 12-inch fan two hours.
Vulcanize four automobile tire patches.
Keep foot warmer hot one-quarter hour.
Raise passenger elevator five stories in a minute.
Operate electric griddle eight minutes.
(Calculating current at 10 cents per kilowatt-hour rate.)

Searchlights and Radio Aid European Warriors

GERMAN SEARCHLIGHT THROWS BEAM EIGHT MILES.

The German military authorities, with proverbial thoroughness, have appropriated every branch of science available for the most expeditious conduct of scientific warfare, both on land and sea. This is exemplified in a marked manner by their very extensive employment of powerful electric searchlights, which are kept continually flashing through the night atmosphere in search of the enemy.

The searchlights are often used in groups of considerable numbers when a night attack is to be made by infantry or trenches are to be stormed. In other cases they prove extremely valuable to the artillery range finders, as otherwise it is often very difficult to make effective use of this arm of the military service at night.

In the illustration herewith a German officer is making observations by means of one of their extremely efficient searchlights recently developed for use in the famous Flanders region, which extends for miles. It is possible for these searchlights to throw a strong beam *eight miles* away, even on cloudy nights.



Photo Copyright by Underwood & Underwood

A Powerful German Army Searchlight in Action at Night in the Famous Flanders Region.

ELECTRICALLY HEATED UNIFORMS NOW.

Austrian soldiers will not suffer from cold weather if the electrically heated garments which have just been invented by the professor of electricity at Innsbruck University prove feasible. The essential feature of the professor's invention, according to the Austrian newspapers, is a method of weaving electric heating threads into soldiers' pants and coats and then connecting the threads with a battery or supply wire at a distance of from 100 yards to a quarter of a mile. It is asserted that the current can be regulated so that any number of soldiers in the trenches can be kept warm simultaneously.

EDISON OPENS ELECTRIC SCHOOL.

An experimental school of electricity for the officers and men of the United States navy has been opened at Orange, N. J., by Thomas A. Edison, chairman of the Naval Advisory Board, acting in co-operation with Secretary Daniels. The men of the submarine flotilla who have to do with complicated electrical equipment will receive their training first.

Fourteen officers and 30 men from Quincy, Mass., and the New York navy yard recently finished a course.

A WIRELESS MOTORCYCLE FIELD STATION.

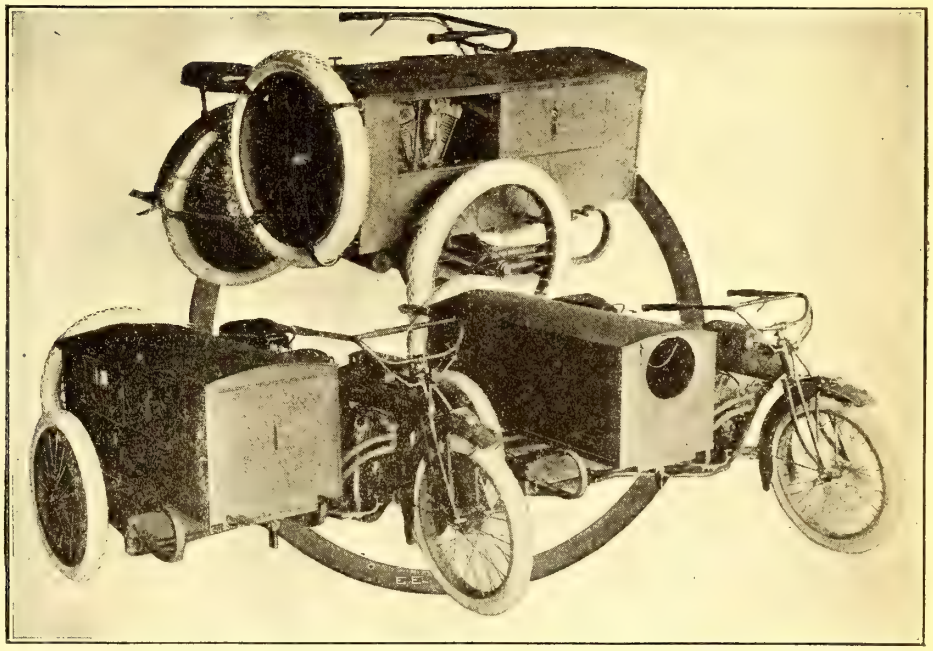
A number of "Indian" motorcycle wireless stations, which may be moved at will from point to point, have just been completed at Springfield, Mass. Besides the original instrument van and the machine to haul it, an additional feature is another motorcycle and van which serves to carry poles, wires, tent, blankets and other paraphernalia for camping, thereby making each group of the service independent of tall trees and houses on which the field wireless formerly relied for temporary headquarters.

The wireless camp resembles somewhat a battery of field artillery in its plan, having essentially one motorcycle unit which hauls the wireless sending and receiving equipment either in a side carriage or trailer, corresponding to the field piece, and another motorcycle hauling the service van, corresponding to the ammunition caisson. Having two machines in each set, the service consequently embraces 10 motorcycles and vans. The wireless operator rides behind the driver of the motorcycle on a spring tandem seat.

Power for the wireless station is furnished by a 5½ horse-power twin cylinder engine, set up in one compartment of the van, which drives by direct chain drive a small two-in-one receiving and sending electric generator. The varying speeds at which the engine or generator may revolve are transmitted through a direct-drive chain, running on a compensating sprocket at the shaft of the generator, which insures smooth running. On its sending side the generator develops 700 volts, 2.6 amperes, being capable of sending a message nearly 500 miles by wireless, and on the receiving side 110 volts, 2.7 amperes for the audions. The operator's instruments are in the forward compartment of the van and when a halt is made, to set up communications, he removes the keyboard some distance from the power plant in order to hear better. He regulates the power of the engine by magnetic control of the throttle. Starting of the engine is accomplished by turning over a hand lever.

A supply of gasoline sufficient for 12 to 24 hours' continuous operation of the plant may be carried in the regular tank and three reserve tanks. The capacity of the gasoline tank on the motorcycle is sufficient for 100 miles of travel.

The weight of motorcycle and wireless van is about 1,176 pounds. The box is 4½ feet long, 21½ inches wide and 20 inches deep.



Type of Motor-Cycle Radio Pack Sets Now Being Built for Rapid Transit Over Battlefields.

Historic Telephones

WHEN we step into the nearest telephone booth to-day and without the slightest trouble or delay are swiftly connected with our desired party, perhaps hundreds or even thousands of miles away, we do not always, or, in fact, rarely, stop to think of the vast amount of labor and gray matter expended on the telephone in the past 40 years, during which time it has slowly but surely developed into one of the greatest industries in the world's history.

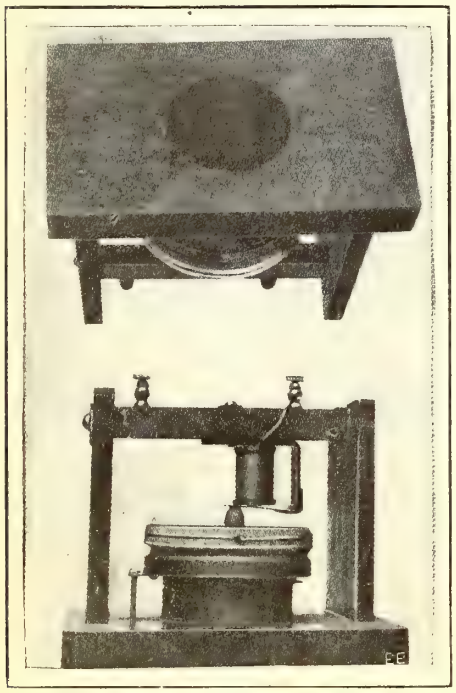


Fig. 2. Two Views of the First Bell Telephone Model, Utilizing a Diaphragm of Gold-Beater's Skin.

We present herewith a number of interesting illustrations depicting the early models of the speaking telephone as perfected by Alexander Graham Bell and his assistant, Thomas A. Watson. In the year 1874 Prof. Bell was intensely interested in developing a harmonic telegraph instrument. The appearance of one of these devices is perceived at Fig. 1. These consisted of an electro-magnet supported on a yoke, and on the upper end of this yoke there was clamped a steel rod or spring of a certain musical pitch. It was Bell's idea that if, say, six of these instruments were hooked up to a common two-wire circuit, then it would be possible to transmit six distinct telegraphic messages over this line simultaneously, if each of the transmitter springs were of a different musical pitch. Each spring at the transmitter end of the line carried suitable contacts, so as to make and break the line circuit current, and, moreover, each transmitter spring would vibrate at a certain frequency, owing to its being tuned in the manner described.

The discovery of the speaking telephone is directly allied with this seemingly unimportant piece of apparatus. This wonderful event occurred during a test of the musical telegraph apparatus conducted by Messrs. Bell and Watson on the afternoon of June 7, 1875, at Boston.

It was Watson's task to consecutively and repeatedly set the transmitter springs going on these musical telegraph instruments, while Bell at the other end of the line was busy retuning the receiver springs, one by one. This he usually accomplished by listening to each spring as he held it near his ear.

"One of the transmitter springs I was attending to stopped vibrating," relates Mr. Watson, "and I plucked it to start it again. However, it did not start according to schedule and I kept on plucking away on it, when suddenly I heard a shout from Bell in the next room. And out he came with a rush, demanding: 'What did you do? Don't change anything; let me see!' I showed Bell just what I had done, and the fact of the matter was that the make and break contact point of the transmitter spring I had been trying to start had become welded together, so that when I had snapped the spring the circuit had remained unbroken, while that strip of the magnetized steel, by its vibration over the pole of its magnet, was generating a current of electricity that varied in intensity precisely as the air varies in density within hearing distance of that spring. The undulating current so produced had passed through the line wire to the distant receiver, which, fortunately, was a mechanism that could transform that current back into an extremely faint echo of the vibrating spring which had generated it."

Bell took full cognizance of this startlingly scientific fact so suddenly demonstrated before him and directly he had built the first telephonic instrument ever devised. This had the appearance illustrated at Fig. 2. The framework was made of wood, while the mouthpiece was formed in the frame itself, as perceived. At the inner end of the mouthpiece chamber was tightly fastened a diaphragm of gold-beater's skin. The center of this diaphragm was joined to the free end of the spring on one of the harmonic instruments. The idea here was to force the steel spring to follow the vocal vibrations developed by the air currents impinging against the diaphragm primarily and thus to generate a current of electricity that would vary in intensity as the air varies in density during the utterance of speech sounds. The first sentence ever spoken over this crude but marvelously correct telephonic device was that spoken by Prof. Bell: "Mr. Watson, please come here; I want you."

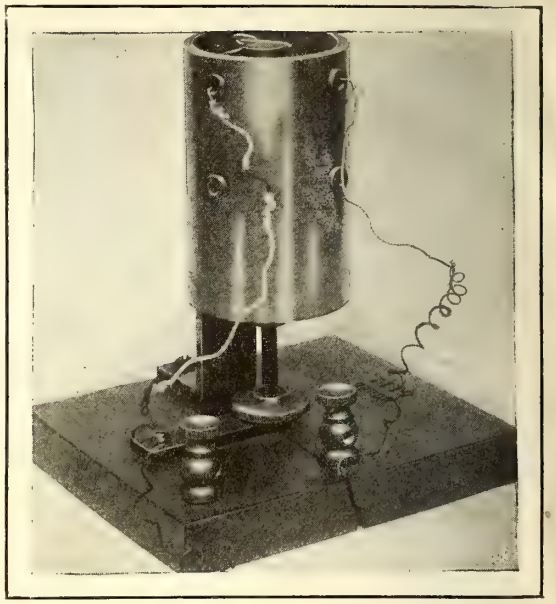


Fig. 4. Original Model Telephone Receiver Exhibited at Centennial Exposition.

Hundreds of different ideas were tried out in the early days of the telephone, such as various sizes and kinds of diaphragms, magnets, mouthpieces, ad infinitum.

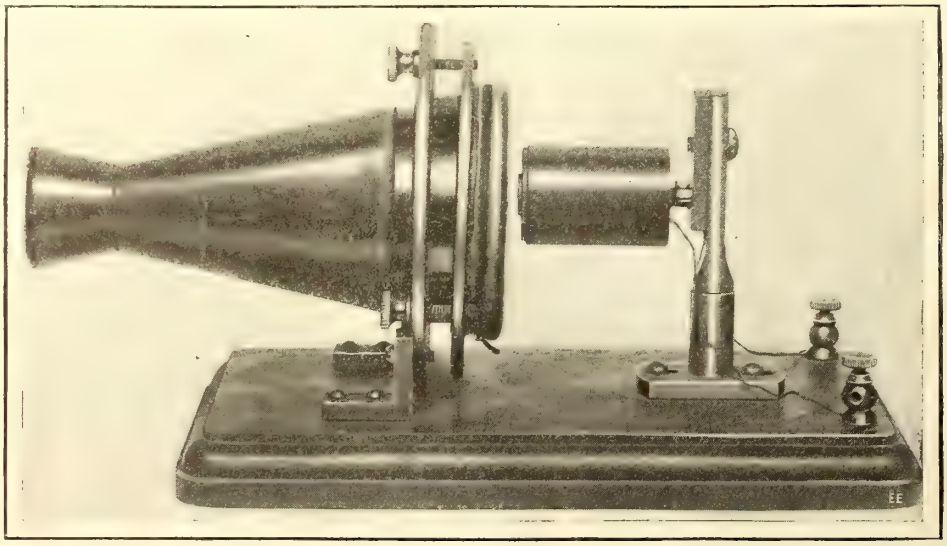


Fig. 3. The First Magneto Telephone Model (for Transmitting) Exhibited at the Centennial Exposition, Philadelphia, in 1876.

At the Centennial Exposition held at Philadelphia in 1876, and although the telephones of Prof. Bell were hardly ready for a practical demonstration on such an auspicious occasion, he finally was persuaded to exhibit a set of apparatus. The instruments were finished up in the best manner possible and worked very well indeed, considering that but a small amount of research work had been carried out to develop them at this time. The original Bell magneto transmitter exhibited at this Exposition was of the type illustrated at Fig. 3. The receiver or reproducer of the spoken word appears at Fig. 4.

The transmitter demonstrated on this occasion employed a non-metallic diaphragm stretched over the inner opening of the

mouthpiece chamber, and to its center was secured a small piece of iron in the form of a disk. When the voice was projected

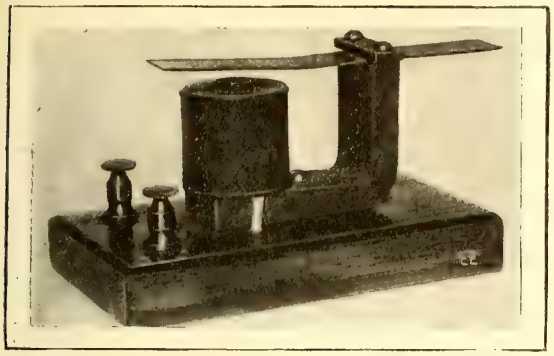


Fig. 1. Forerunner of the First Telephone; the Harmonic Reed Telegraph Devised by Prof. Bell.

into the mouthpiece the undulating air currents caused the diaphragm to vibrate in the same manner as it does in the instruments used to-day and corresponding electric currents were set up in the magnet coil mounted directly back of the diaphragm. These currents passed out over the line wire to the receiver of similar pattern, shown at Fig. 4.

Many distinguished visitors to the exposition heard the telephone talk and were astounded beyond words. The Emperor of Brazil happened to see the telephone on exhibition and asked for a demonstration. He listened intently at the receiving end of the circuit and was utterly astonished when the insignificant-looking device sitting on the table before him gave forth actual speech. He could only exclaim: "My God! it talks."

Sir William Thompson also tried the telephone, which, it must be remembered, was very new, even to the scientists of the day. This gentleman in his report on the telephone after his return home said: "I need hardly say that I was astonished and delighted, and so were others who visited the exhibition and verified it with their own ears, the electric transmission of speech."

The telephone began to develop shortly after this at a fairly decent rate and in April, 1877, the first outdoor telephone line was run between Mr. Williams' office at 109 Court street, Boston, and his house in Somerville. Fig. 5 depicts what was called the box type telephone. This was used in the Boston-to-New York test, which, after quite a good deal of experimenting and changing of line wires, etc., culminated in complete success.

In the first telephones perfected for single circuits no method was available for calling the party at the other end of the line when one wished to carry on conversation with him. Therefore when the telephone began to spread out and longer lines were in vogue, and especially when the first exchanges or central offices were started, some form of calling device became absolutely necessary.

It was common in the earliest instruments installed for the party doing the calling to thump against the diaphragm of the apparatus with his pencil. Sometimes the pencil was not handy, so the next step was to use a sort of thumper. This is shown at Fig. 6. At the left of the apparatus, as observed, a small "calling" push button projected from the front of the cabinet. When this was pressed it actuated the small hammer, and in this way the thumps against the diaphragm were transformed into an undulating electric current which passed out over the line, giving rise to corresponding diaphragm "thumping" notes at the receiving instrument. Thus did the early 'phone subscriber notify the party wanted at the opposite end of the circuit that they were wanted at the instrument. To-day your 20th century 'phone user wants "instantaneous service" and no half-way business about it. Did you ever stop to contemplate what havoc would ensue in the present business world with its thousands of diversified ramifications, if all the telephone lines were suddenly severed?

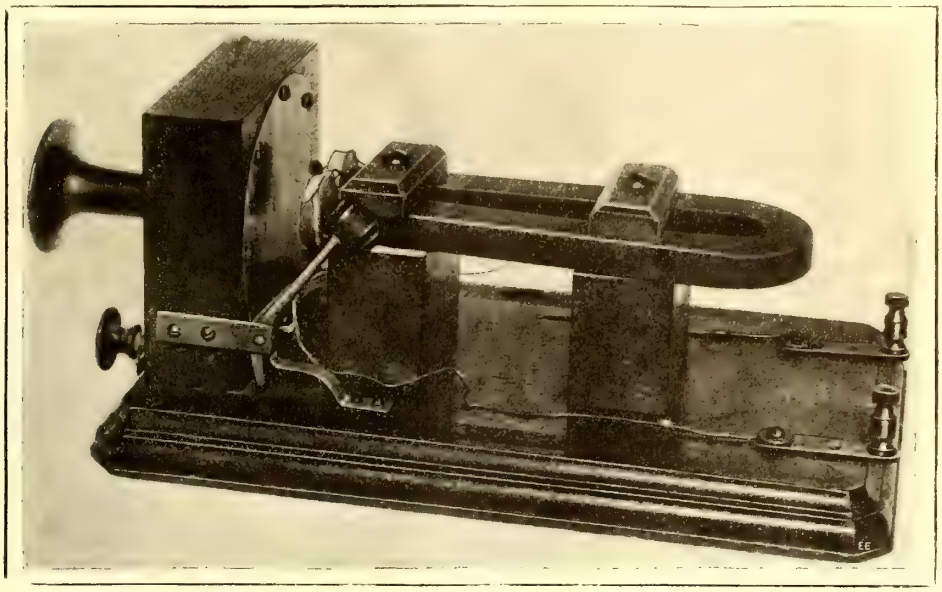


Fig. 6. One of the First Practical Telephones Developed. It is Equipped with a Calling Hammer, as Observed, Which "Thumped" the Diaphragm and These Signals, Reproduced at the Receiving Instrument, Notified the Party Wanted, but Not in the Most Gentle Manner, to be Sure.

"The 'Watson thumper' brought me only a fleeting fame," says its inventor, "for I soon superseded it by a magneto-electric call bell that solved the problem, and was destined to make a long-suffering public turn cranks for the next 15 years or so, as it never had before, or ever will hereafter.

"Perhaps I didn't have any trouble with the plaguey thing! The generator part of it was only an adaptation of a magneto shocking machine I found in Davis' Manual of Magnetism and worked well enough, but I was guilty of the jingling part of it. At any rate, I felt guilty when letters began to come from our agents reciting their woes with the thing, which they said had a trick of sticking and failing on the most important occasions to tinkle in response to the frantic crankings of the man who wanted you. But I soon got it so it behaved itself and it has been good ever since, for Chief Engineer Carty told me the other day that nothing better has ever been invented, that they have been manufactured by the millions all over the world, and that identical jingler to-day does practically all the world's telephone calling.

"For some reason, my usual good luck I presume, the magneto call bells didn't get my name attached to them. I never regretted this, for the agents, who bought them from Williams, impressed by the long and narrow box in which the mechanism was placed, promptly christened them 'Williams' Coffins.' I always thought that a narrow escape for me! The first few hundreds of these call bells were a continuous shock to me for other reasons than their failure to respond. I used on them a switch, that had to be thrown one way by hand, when the telephone was being used, and then thrown back by hand to put the bell in circuit again. But the average man or woman wouldn't do this more than half the time, and I was obliged to try a series of devices, which culminated in that remarkable achievement of the human brain—the automatic switch—that only demanded of the public that it should hang up the telephone after it got through talking. This the public learned to do quite well after a few years of practise."

So the marvelous telephone, once called a device of the devil, has happily prospered to make man's work easier than ever before.

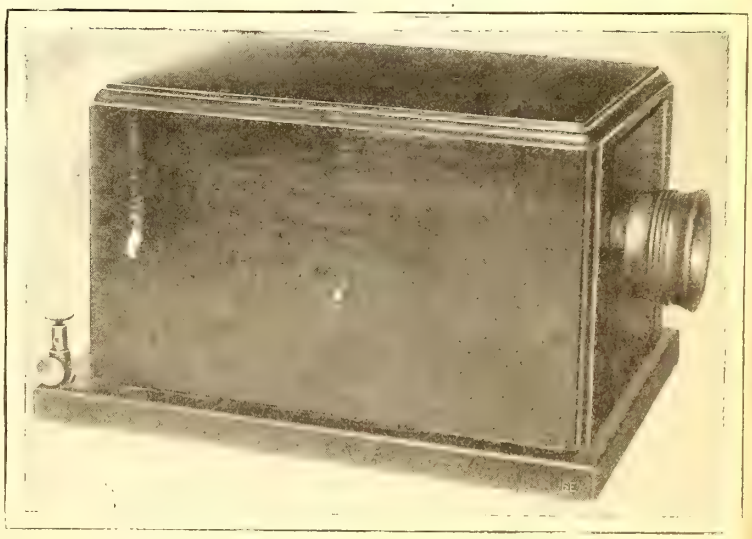


Fig. 3. Early "Box" Type Telephone Used in the Boston-to-New York Tests. A Wonderful Achievement in Its Day.

Lightning, Its Effects and How to Avoid Them

With the Approach of Summer it Behooves Us to Learn All We Can on the Subject of Lightning and Protection from Same. The Safest Place for Individuals During Thunder Storms Is Covered Herein.

By H. Winfield Secor

NO electrical discharge ever produced by mortal man can approach the awe-inspiring and wonderfully spectacular electrical displays taking place in nature and which we know as *lightning*. Lightning is an electrical discharge caused by the air breaking down where two opposite electric charges exist on two adjacent clouds or between the earth and a cloud.

"The prime cause of lightning is the sunbeam," says Prof. West Dodd. The cloud does not gather electricity out of the air as many people imagine. The electrical energy in the cloud is due to sun heat which brings about the rapid evaporation of water.

Heat is one of the nine forms of energy, and when evaporation of water takes place, the sun heat that caused the evaporation changes into one of the other forms of energy. The little globules float away, each carrying its own little quantity of "energy" or "strain" on its surface, and when the countless billions of these energized, invisible globules rise to the sky, where the cold of elevation rapidly condenses them into raindrops, this energy is released in the form of electricity, ready to give back the energy of the sun condensed into lightning flashes.

Our philosophers try to teach us this: "Before the house is struck by lightning an electric strain is placed upon it." That is, a condition has been coaxed into it, and it is this condition we have to deal with if we would prevent it from bursting into a lightning explosion.

But if a fog extended from the cloud to the earth, this condition would not exist, as the electricity easily reaches the earth through the fog by conduction and thus no lightning is produced.

Also you possibly remember that you never saw lightning on a foggy day, but when the air is dry the earth directly beneath the charged cloud is electrified in sympathy with the cloud and tries to discharge to the cloud the same as the cloud tries to discharge to it, and a great electrical strain is set up between the cloud and the earth.

The air is a poor conductor of electricity; and things that stick up from the earth into the air, like houses and barns, become discharging points for the earth's electricity, and in this way the house really prepares to be struck.

So the lesson we wish to impress here is this: Lightning is due to causes. Electricity first gets in its work and loads up a cloud. Then this cloud fixes up things on the earth and induces an opposite electric condition, and the two electrified surfaces strain and pull on each other; then when the strain becomes great enough so that the air cannot resist any longer, off it goes with an explosion through the house, and probably the undertaker has a job on his hands.

Having shown as clearly as possible in so short a time the cause of lightning and how the flash is brought about, let us consider briefly the remedy or how the stroke may be averted.

Let us begin by calling to mind that there are some things lightning will not strike. There is a reason for it. "Chance" is unknown in the operation of nature's forces. There is no safer place on earth from lightning than in a steam engine or in a railroad coach. No one was ever known to be injured by lightning when in a railway train. Lightning will not strike the business part of a big city. The tall skyscrapers of our large cities are immune from lightning, and insurance companies never have any losses from lightning on any building with metallic sides and frame work of iron and steel. It will not strike a modern battleship, on account of the material of which it is constructed, and a steel windmill tower is never injured by lightning. The reason is that every one of these objects is its own lightning rod. They need no further protection.

But there are things lightning will strike. Lightning will strike a country home, or a home in the suburban part of the city. Lightning will strike a barn or a church or a schoolhouse or a tree or a stack or an animal, especially if near a wire fence. All of the lightning losses our insurance companies have to pay are on this class of risks, and a man has to be blind almost purposely, not to see room for thought in these observations.

Where is the safest place in the house during a thunderstorm? Your metallic bed. This may surprise you, but at night the safest place is sleeping in an iron or brass bed. To stand by the metal bed is very dangerous, for you are taller than the bed, but lying on it is safe, as the bed extends above and below you, and the current will not have the bed to pass through you, also the current will not leave it, but the walls above the bed and the floor beneath would be ripped to pieces. Contrary to popular opinion, feather beds are not safe to sleep on, unless they are in a metal bed frame. If you are sleeping on steel springs in a wooden bed, the springs would save you if you are in the center of the bed, while the bed posts would be split to pieces and possibly the bed would be set on fire. During the day the safest place is in the center of the room if away from the stove. Open doors and windows make no difference, as lightning does not come in at open doors, as many people imagine, says Prof. Dodd.

Referring to the illustrations herewith a particularly heavy lightning discharge is observed at Fig. 1. A series of multiple flashes emanating from a cloud of high electrical activity is perceived at Fig. 2. The illustration at Fig. 3 shows a lightning bolt striking in a field near a building. This is a particularly bad form of discharge and its path is quite direct, as may be observed. Fig. 4 illustrates a rather common form of lightning discharge which is very beautiful to be sure. In this case the lightning tends to discharge between one cloud and several other clouds, providing in this way a most spectacular effect, lighting up the whole sky. Very little thunder accompanies such discharges as this one for the lightning takes place so far above the earth that the thunder (sound caused by the lightning flash), or at least the greater portion, does not reach our ears. The illustration at Fig. 5 shows the lightning flashes often observed in the country or suburban districts. The display in this case is particularly severe, as there are two distinct flashes occurring simultaneously. The heavier discharge seen in the distance has no doubt proved very disastrous, judging from its appearance, to any building or structure of similar nature which might have been in its path.

In many instances the lightning simply strikes the earth without harming any one or any structure such as a house or barn. All electrical transmission, telegraph and telephone systems suffer to a greater or less extent from lightning during the summer months. Suitable protective measures have to be taken accordingly. Lightning protective apparatus such as minute spark gaps and the like are installed on such circuits, with proper ground connection attached to the gaps, etc., so that any heavy current produced on these lines by lightning discharges will pass to the earth without entering the switchboards, thus burning out delicate and expensive apparatus, besides often proving fatal to human life.

With regard to the potentials of light-



Fig. 1. A Particularly Heavy Lightning Flash.



Fig. 2. A Series of Multiple Lightning Flashes Emanating from a Cloud of High Electrical Activity.

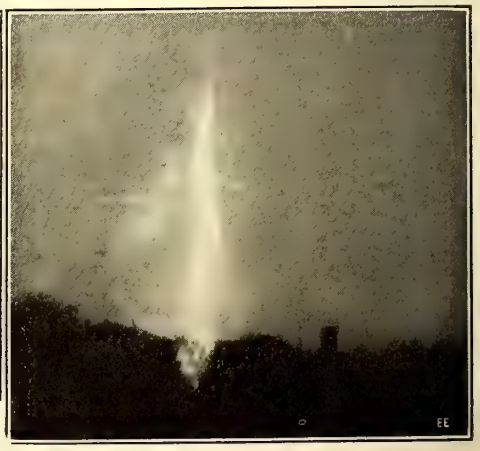


Fig. 3. Lightning Bolt Striking in a Field.

ning flashes but little more than estimates are available. The potential required to cause a flash of lightning a mile long has been estimated by Lodge to be 5,000,000,000 volts; using as a basis the breakdown voltage of air, which is about 30,000 volts per cm. Although this seems rather improbable it can be shown by calculation, based on experimental evidence at hand as to the electric charges of falling rain, that such voltage conditions may be realized. Prof. Trowbridge, however, has cast doubt over the validity of these figures by means of experiments with voltages exceeding a million, which seem to indicate that with long air gaps and extremely high potentials, air may exhibit properties quite different from those shown under the voltage conditions which have hitherto been realized. In designing a system of lightning rods the only potentials which need to be considered are those set up in the system itself.

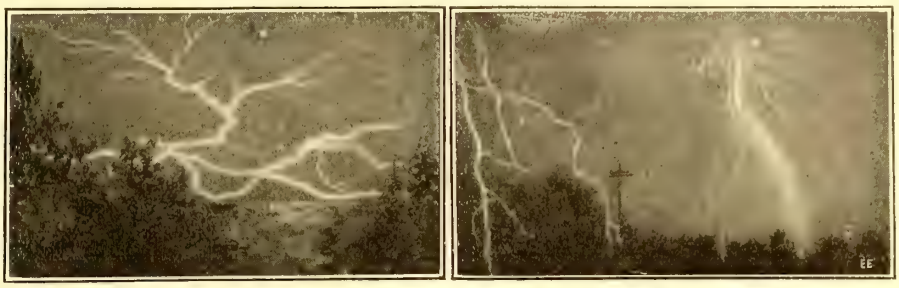


Fig. 4. (Left), Illustrates a Rather Common Form of Lightning Discharge Often Seen Over Bodies of Water. Fig. 5 (Right), Double Flash, Often Observed in Suburban Districts.

The well-known flickering of lightning flashes, which is visible to the unaided eye, indicates that a flash of lightning does not always consist of a single discharge of electricity, but, on the contrary, consists usually of a number of successive discharges which follow each other with very short time intervals between them. By standing where the light from a flash does not blind the eyes, an observer can detect the successive discharges for each complete flash of lightning, the number of which varies, for different flashes, from 2 or 3 to 10 or more.

The frequency of a stroke of lightning has been calculated by Emde, by assuming (1) a circular conducting cloud and a circular portion of the earth's surface situated symmetrically below it; between these the lines of force are normal to both; (2) a concentric cylinder occupied by incandescent gas between the cloud and the earth; (3) that the current density is the same in each cross-section of this cylinder, i.e., that no waves exist along the gas column. By making additional assumptions in regard to the diameter of the cloud and flash, Emde finds a frequency of from 2,000 to 8,000 cycles per second, or an average of 5,000 cycles. There is some doubt, however, as to the validity of Emde's assumptions, and his results should, perhaps, be taken only as in some degree confirmatory of the opinion which more or less generally is held that lightning is, in effect, an electrical discharge of medium frequency; that is, *hundreds of thousands of cycles per second;* as distinguished from low frequencies of a few hundreds of cycles per second, or high frequencies to a million or more cycles per second; and in most cases is of sufficiently steep wave front to excite secondary high-frequency phenomena, even though it may be so rapidly damped as to be practically a unidirectional discharge. To state definitely what ranges the frequency of lightning discharges may cover, however, requires that much more experimental work be done.

From data in several fire tables covering a period of 19 years prior to the year 1903 given in a publication issued by the Government on "Lightning and Protection from Same," there is shown that out of 146,618 fires from all causes in barns, stables and granaries, there were 14,968 caused from lightning. These figures include the total of all fires both known and unknown. The percentage of fires caused by lightning having been 10.2 per cent. The per cent. of fires from known causes and which were due to lighting comes up to 21.5 per cent. At any rate and especially from statistics obtained by various insurance companies in the Central and Western States, where there are a great many isolated barns, dwellings and other buildings, owing to the large farming sections, there is a great risk incurred during the summer months by lightning destroying or partially destroying such structures and also killing live stock. Animals are often killed by coming in contact with charged fence wires. In the Eastern part of the United States not much attention is paid to protection from lightning as in general there are a greater number of cities and also steel frame buildings are more in vogue. Such buildings and also where dwellings or other edifices are gathered into solid blocks and in addition provided with metal roofs connected to the ground through leader pipes, etc., the lightning has very little chance to create any disruptive discharge, but instead is dissipated noiselessly into the earth through the greater surface leakage thus provided for it.

In the case of isolated frame structures or other buildings, not provided with steel framework, there is only one safe method to follow for the protection against lightning, and this is to install proper lightning rod systems. Every isolated dwelling, barn and other outbuildings of any consequence should be protected in this way from the ravages of nature against the electrical demonstrations of which it is not safe to gamble or bet.

The safe way is the best way, and it seems as in many other lines of human endeavor the modern systems of *rodding a house,* as it is called, for lightning protection has eliminated the old-time glass insulator, which was ridiculously small and in fact, if anything, conduced to the disruptive or flash discharge of the lightning current.

Regarding lightning protection by means of metal wires or rods properly placed over a building, and particularly at all of the highest points of the roof of same, such as chimneys or gable peaks, this is well covered in what is known as "The Phoenix Fire Office Rules for Lightning Rods."

Sir Oliver Lodge, the famous English scientist, has made an exhaustive study, in so far as possible, of lightning and its effects on buildings toward the end of protecting them by metal wires properly erected over or installed on the building itself. It has been found that to guarantee the utmost protection in this direction, the building should be literally enclosed in a heavy cross-connected wire frame work resembling a bird cage. It is manifestly quite impossible to go to any such expense or to have a building so thoroughly covered as to become unsightly with any such arrangement as this.

In a modification of this system for an ordinary building, a sufficient practical approach to ideal conditions can be attained by taking advantage of the extent of metal work outside it and adding a few other conductors, so as to surround it and imitate roughly a metallic inclosure. Under expert supervision this can be accomplished by utilizing the rain-water pipes and gutters as part of the system. Joints in the pipes and gutters act more securely when "bonded" together or made electrically continuous. The ordinary conductors must be fixed in addition, and the whole system of pipes, etc., together with the special conductors, may advantageously be interconnected by a horizontal conductor taken round the buildings, either two or three feet above the ground level or buried in the ground.

The complete system should then be efficiently connected to earth at several places.

A building with trees adjacent to it, or dominated by a steeple or other lofty building, must not be considered as immune. A discharge is seldom solitary, along one single path; it is often an assemblage or bush of flashes, and all points in the neighborhood are liable to be struck by some of the subsidiary or accompanying discharges. Even underground cellars have been so invaded.

Material of conductor. Material should be of copper tape at least 1 inch by ⅛ inch, or of a stranded copper rope of not less area; no cable to be smaller than that composed of seven strands, each of ⅛ inch diameter, or of soft iron cable, properly galvanized or sheradized; the total sectional-area of iron cable need not be greater than that of copper, except for chemical reasons and permanence. In inaccessible places, and atmospheres where chemical corrosion may be feared, copper should be used of larger sectional-area than 1 by ⅛ inch.

Conductors should be run in as direct a line to earth as convenient, and sharp bends and joints avoided; they should be kept a certain distance away from the walls. The object of keeping conductors a certain distance away from walls is to prevent accumulation of dirt, and to avoid sharp bends when passing over cornices, etc., *but they must not be insulated from the walls.*

For tape conductors all joints must be carefully soldered and made electrically and mechanically continuous, i.e., screwed together or clamped. Stranded cable conductors should be connected by lineman's joints and soldered or united by a special joint box. After the strands of the cable are twisted together, the box should be filled in with molten solder.

Elevation rods should be of solid copper or galvanized iron of ample cross-section and fixed at least two feet above that portion of the building to which they are attached by a sleeve joint soldered and pinned, or by means of a box-joint filled with solder and pinned. In the case of chimney stacks, the rod must extend at least one foot above the highest chimney in the group which forms the stack.

Hold-fasts should be of gun metal or brass for copper conductors or of malleable iron for iron conductors and let into the wall in such a manner as to support and keep the conductor away from the structure at such a distance as will avoid any-

(*Continued on page* 737.)

A "Hook-less" Telephone Receiver the Latest

By Samuel Cohen

ALL telephone instruments now in use require a "hook-switch" or its mechanical equivalent upon the proper manipulation of which, among other things, depends the efficiency of the telephone service. All calling and clearing-out signals, without which it is impossible to operate a modern telephone exchange service, are now transmitted by the subscriber in the act of removing his receiver from and restoring it to the *telephone hook*. This is pivoted or otherwise mounted in bearings in such a manner as to make alternate contact with upper and lower spring connections, designed to open and close the respective electrical circuits. If the receiver is accidentally left off the hook after the conversation is finished, the line is reported "busy" to all inquirers until the error is eventually discovered and rectified by Central.

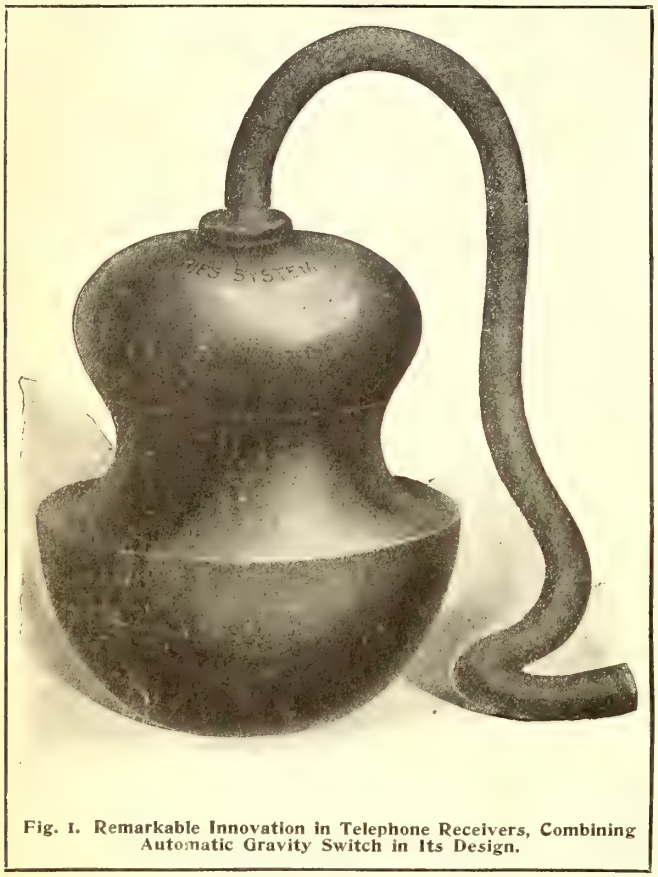


Fig. 1. Remarkable Innovation in Telephone Receivers, Combining Automatic Gravity Switch in Its Design.

In a recently devised automatic gravity switch telephone the hook-switch together with the other complicated features of the present apparatus are entirely done away with. The telephone receiver, which is shown in Fig. 1, has a spheroidical shape and is about the size of a pear. As perceived from Fig. 2, it contains within itself all the requisite switching mechanism. The sectional view clearly illustrates the inner parts of this very unique telephone receiver. A small quantity of mercury or an equally mobile conducting substance is enclosed within a hermetically sealed, conical shaped switching cup made of iron or steel, in which it is free to move under the influence of gravity. When the receiver, which requires no hook support and is, therefore, mechanically independent of the transmitter, is lifted from the normally vertical position (which it assumes when hanging by its cord or when resting on a table) to an approximately horizontal one, assumed when placed to the ear, the mercury immediately changes its position and moves from the lower to the upper portion of the conical cup. In so doing it automatically touches the central disc which is connected to the calling circuit, thus transmitting the calling signal and at the same time establishing electrical connections with the talking circuit. This circuit is made by the mercury and the upper right terminal in Fig. 2.

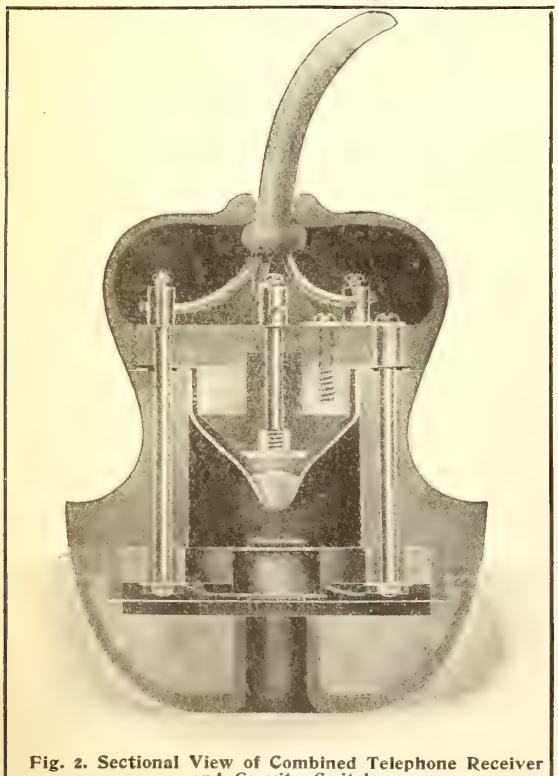


Fig. 2. Sectional View of Combined Telephone Receiver and Gravity Switch.

The natural act of putting down or releasing the receiver from the hand after conversation is finished causes the mercury to flow back to the lower end of the cup and in so doing (provided the receiver at the other end of the line has also been set down) automatically operates the "ringing off" or "clearing out" signal at Central, disconnects the talking circuit and restores the subscriber's line to its normal condition ready for another call.

In other words, the natural act of picking up the receiver when one wishes to talk and laying it aside when through causes the automatic and instantaneous action of all the operations which the operator and subscriber have to perform to-day. Thus, for the first time in the history of telephony, there is an elimination of the personal equation of the subscriber from the problem of exchange operation, in which he is now such an important yet at the same time so unreliable a factor.

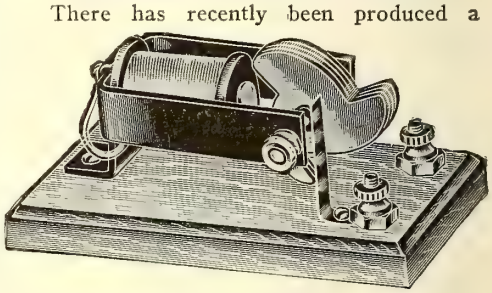
The regular telephone electromagnet, permanent magnet and diaphragm are located at the lower end of the shell, as perceived, in the cross-section illustration, Fig. 2. In desk telephone outfits the hook is dispensed with and the receiver is automatically kept in a vertical position by the heavy metal cap piece at the lower end of the receiver case. This causes it to resume its normal position when laid down ready for further service. In this instrument only the receiver has to be picked up, as the transmitter need not be handled.

Despite its simplicity, containing as it does but one moving part and that absolutely permanent and indestructible, it performs its manifold duties as above outlined correctly, without regard to the skill of the subscriber or users and with far greater precision and promptness than the most careful and experienced subscriber can command under the present antiquated hook-switch system. With this system a great deal of Central's time is saved by unnecessary questions which the operator begins to ask, such as "Are you waiting?" "Are you through?" etc., etc.

This unique automatic gravity switch telephone was perfected by Elias E. Ries, a well-known consulting electrical engineer of New York City, and his system, fully protected by patents here and abroad, will undoubtedly find favor with telephone companies at an early date it would seem.

A NOVEL MONOCOIL MOTOR.

There has recently been produced a miniature battery motor which can be built for probably less money than any other motor ever designed, considering the power of it. This motor is shown in the accompanying illustration. But one electromagnet is used in its operation and one dry cell will operate this motor at high speed. The current through the electromagnet is made and broken as the armature rotates by means of a circuit-breaker mounted on the shaft, against which a spring brush bears. The principle is well known in dynamo-electric phenomena, but very few motors have ever been built of this type. The motor consumes only .4 of an ampere when operated on a single dry cell. The comparatively heavy armature acts as a flywheel, thus causing the machine to develop a surprising amount of power, considering its size.



Simple Battery Motor Utilizing but One Electromagnet.

HIS ONLY POSSIBILITY.

"I believe," said the impatient man, as he put aside the telephone, "that I'll go fishing."

"Didn't know you cared for fishing."

"I don't, ordinarily. But it's the only chance I have of finding myself at the end of a line that isn't busy."

TWENTY-FOUR HOUR CLOCKS.

The 24-hour system of reckoning time was adopted by the telegraph and telephone authorities in Denmark Jan. 1. The system is in use in Sweden, Russia and Norway.

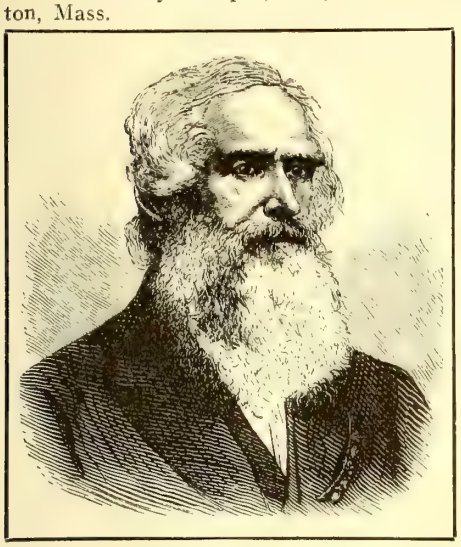
April the Birth-Month of Two Famous Electrical Pioneers

SAMUEL F. B. MORSE.

(Born April 27, 1791—Died April 2, 1872.)

April, 1916, marks his 124th birthday.

Samuel Finley Breese Morse was born on the 27th day of April, 1791, at Charleston, Mass.



Samuel F. B. Morse, Who Developed the First Successful Telegraph.

He started first as an artist, and in order to get better technique studied in Europe twice, during the years 1811-15 and from 1829 to 1832.

During the return voyage from Europe, after his second visit in the year 1832, it happened that he made the acquaintance of Prof. Chas. T. Jackson, of Boston. On the ship he noticed the electrical experiments of the professor, during which the latter made the remark that it should be possible to use electricity as a means of signaling.

After his return from Europe, Morse again devoted all his time to his painting, but he did not seem to make a success of it and was always more or less in financial trouble.

He was the head of the National Academy of Painters, and in the year 1835 received the title of professor. In November of this same year he took up his telegraphic experiments, but inasmuch as he had had very little experience with electricity and as he was not much of a mechanic, he did not obtain any results whatsoever.

In the year 1836 a professor of chemistry, Leonard Gale, gave Morse a great many pointers on electricity, and it was through him that Morse was able to construct his first electro-magnet. As it happened Prof. Gale was afterwards associated with Morse.

Not until the year 1837 were his labors crowned with success and his first apparatus to transmit signals was perfected.

About this time Morse made the acquaintance of Alfred Vail, who supported him financially, and thus Vail also became one of Morse's associates. A good machine was now built and on the 4th of September, 1837, the experiment could finally be called a success, as the first real message was sent over the wires. However, the world did not accept this great invention immediately and at various times Morse endeavored to interest capital in his invention.

O. J. Smith, a member of Congress, gave Morse financial aid and made it possible for him to go to Europe in order to exploit his invention. This, however, proved a failure and he returned to New York in 1839. Morse again resorted to painting in order to make a living. Finally in the year 1843 Congress appropriated $30,000 to put up a large experimental line. This first line, 40 miles long, was erected between Washington and Baltimore and was tested out primarily in May, 1844. Morse's apparatus during this time had undergone a great many changes and very much resembled the present day telegraph instruments.

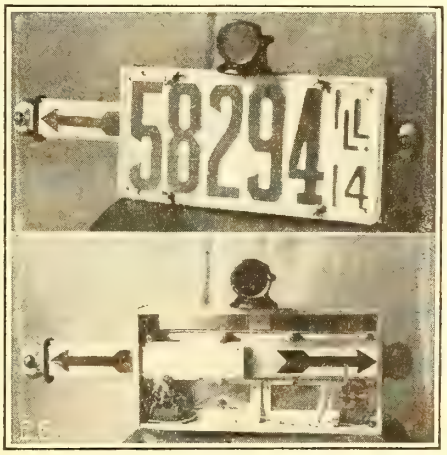
After this, in an astonishingly short time, Morse's telegraph found its way all over the world. Morse became electrician for the New York and Newfoundland Telegraph Company. In the year 1857 ten of the countries of Europe united in presenting him with a gift of $100,000.

He died in a suburb of Poughkeepsie, N. Y., April 2, 1872, leaving a name long to be remembered among all people.

NEW ELECTRIC AUTO SIGNAL SAFEGUARDS DRIVER AND PUBLIC.

By Lester L. Sargent.

A new electrically operated direction bar or arm for automobiles, invented by Ralph B. Baker, takes the place of a person's arm in indicating which way the car is to turn in rounding corners. The device is combined with the license plate. That is, the license plate is fastened over the box which contains the electric motor and gear wheels which engage two electric bars, one of which is arranged to mesh with a ratchet bar attached to each direction arm. There are two direction arms, one adapted to reach out at either side of the license plate. Arrows are painted on them and they also carry a signal light at the outer end to render them conspicuous at night. The device may be used independently of the license plate, but for reasons of economy and convenience the plate carrier is utilized to contain the electric mechanism that operates the signal arms. The tail light is mounted over the license plate, so as to illuminate both that plate and the direction arms or bars. The small electric motors required for the operation of the device can be operated from the ignition battery of the car.



Open and Closed Views of New Motor-Driven Auto Signal Intended for Rear of Car.

NEW ZEALAND TELEPHONES.

The telephone system of New Zealand is being rapidly developed by the National Government with up-to-date material and appliances, much of which is now coming from the United States.

RAIMOND LOUISE GASTON PLANTÉ.

(Born 1834—Died 1889.)

April, 1916, marks his 82d birthday.

The electric storage battery has come into such general use since the advent of



M. Raimond Louise Gaston Plante, Inventor of the Storage Battery.

the automobile, the electric truck and the submarine that it is well to remember that its development was due to Gaston Planté.

It should not be forgotten that the chemical storage battery does not actually store up electricity. When the battery is being charged the flow of current causes a certain chemical action to take place in the battery. When the battery is discharged this process is reversed and the chemical reaction sets up a flow of electricity.

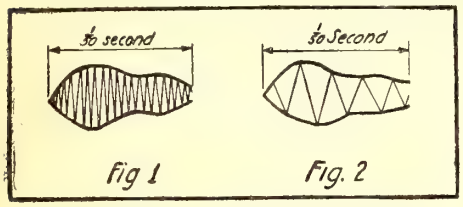
Raimond Louise Gaston Planté was born at Orthez, France, April 22, 1834. He was educated at the Conservatoire des Arts et Metiers in Paris. His profession was that of a chemist, and his principal work was the investigation of the nature of electrical polarization, which finally led to his discovery of the lead accumulator, which bears his name and has given him his fame.

He was always an indefatigable experimenter, and as a result of his experiments on the discharge of cells, he developed a weakness of vision, which greatly handicapped him and which led, in 1862, to his retirement to private life. In 1860 he was appointed to the chair of Professor of Physics of the Polytechnic Association in Paris.

Planté's best-known work is "Recherches sur l'Electricité," issued in 1879, this covering his contributions to the Academy of Science. An immense number of experiments are described in this book, including those which were made with a lead battery of no fewer than 800 elements. It also included a brief description of his rheostatic machine, for which he received the Academy of Sciences prize in 1881. Planté received the diplome d'honneur at the Paris Exposition in 1881 and was also made a Chevalier of the Legion of Honor. It is said that the name of Planté ought to be handed down with those of Volta and Ampère as among the immortal founders of the science of electricity. Renowned for his modesty and amiability, he never troubled about securing patents during the development of his discoveries—although he was fully alive to their possibilities, preferring to let the world benefit by the additional experiments and discoveries of other scientists. He died at Paris, May 5, 1889.

A Writing Machine That Responds to the Voice

WHILE there are many highly ingenious electrical instruments available and in commercial use to-day, including the almost human Telautograph, which will transmit and reproduce ordinary writing, sketches, etc., over an electrical



Demonstrating the Wave Form Characteristic of Letter "B," Uttered Normally at Fig. 1; at a Lower Pitch at Fig. 2.

circuit of considerable length, there is nothing that will more astound the layman than a contrivance so perfectly devised that it will typewrite a message corresponding to any speech delivered vocally to it. In other words, a writing machine that will respond to the voice directly has been the goal striven for by a Brooklyn, N. Y., electrical engineer, John D. Flowers.

Several years ago there were articles published in the technical press about a voice-operated typewriter devised by this inventor and the different letters of the English alphabet were controlled in that case by suitably arranging a number of differently tuned reeds. As the different reeds corresponded to the various characteristics of speech, it becomes evident how this arrangement might work out. This scheme operated fairly well when simple words were clearly spoken in the receiver of the instrument, but it was difficult for this hyper-scientific mechanism to distinguish the consonants.

Much time was spent in experimentation on the failure of the machine to respond to these consonant sounds, but without avail, and finally the inventor concluded that what was required was a much closer study of the minute, and, as we now know, the exact changes and fluctuations of the human voice when uttering any certain sound. For instance, the difference between two speech sounds, such as B and D, was apparently not one of wave frequency. Any change in the number of sound waves would only raise or lower the pitch; however, the characteristic B and D sounds are distinguishable whether or not they are spoken by the highest soprano or lowest basso.

Mr. Flowers went into the study of this subject very exhaustively and, having decided that there were too many complicated side tones and irrelevant tones, such as fundamental and overtones produced by the vocal cords, he arranged an especially sensitive electrical device to pick up and record on a moving strip of film a whispered tone. It has been proven from many exhaustive experiments on a great number of persons of both sexes that these whispered tones in any case will correspond to a certain definite form or pattern for each letter sound of the alphabet. To make this matter clearer, reference is made to Figs. 1 and 2, where the characteristic intensity curve of the "B" sound is shown at 1, while the intensity curve of the "B" sound uttered at a lower pitch is shown at 2. It is observed that in both cases the letter sound pattern is the same and this fact Mr. Flowers succeeded in establishing beyond any question. He has succeeded, with the aid of the apparatus shown at Fig. 3, in producing a complete alphabet of equivalent phonetic, letter sound patterns, as indicated at Fig. 4.

Referring again to the apparatus employed for studying the characteristics of human speech, as shown at Fig. 3, there was utilized an Einthoven galvanometer with silvered quartz fiber which was caused to vibrate by the current generated in a secondary of a step-up induction coil, as illustration indicates. The primary of the induction coil was connected in series with a telephone receiver (used as a check on the test conducted); a controlling resistance of approximately 500 ohms value; a single storage battery cell and an Acousti-

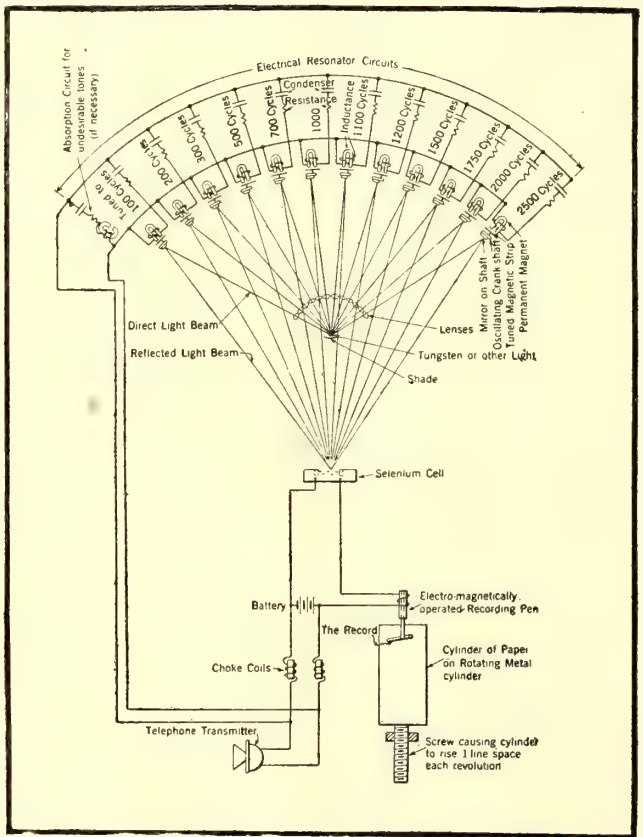


Fig. 5. Arrangement of Electrical Circuits and Allied Devices Used in Writing the Spoken Word Directly.

con microphone or transmitter. As is generally known, this transmitter is used to a great extent in aiding partially deaf people to hear better, and it is so remarkably sensitive to sound waves that *whispers* have the same effect as would the ordinary tone of voice on the standard microphone supplied with the common Bell instruments.

An arc lamp was used to give a strong beam of light, which was intensified through a series of lenses, with the result that the slightest motion of the galvanometer string was magnified 900 times when it reached the recording film in the camera observed at the right of Fig. 3. The galvanometer string consisted of a fine silver-plated quartz fiber .0001 of an inch thick, supported between the two poles of a very powerful electro-magnet. The ray from the arc lamp was focused upon this quartz fiber through a hole in the magnet poles, and by means of a second system of lenses the image of the string was photographed as a spot on the rotating drum of the camera. Whenever a sound was whispered in the proximity of the Acousticon microphone the latter varied the current of the primary and conjointly the secondary current of the induction coil and which effect was manifested in the galvanometer by the string vibrating more or less in accordance with the strength of the sound and its particular letter characteristic.

When the shadow of the galvanometer string moved back and forth about two inches the electrically operated camera shutter was opened for one revolution of the wheel and a five-foot photographic record of the word whispered was thus obtained. While many speeds, even as high as one mile per minute, were tried, the rate of 1,080 feet was found suitable for most of the work. The light from the arc was interrupted 500 times per second, and in this way vertical lines were automatically photographed on the moving film at intervals of two-thousandths of a second, by virtue of a specially constructed time wheel.

Mr. Flowers, in speaking of his work in this direction, states that speech patterns so photographed on the moving film and of the same identical sound are practically exactly alike for all persons and independent of their age or sex. In this fashion 500 different records were obtained of three men's speech and one woman's to substantiate the arguments here set forth. This work was conducted by the co-operation of the Department of Physiology, College of Physicians and Surgeons, New York, and the Underwood Typewriter Co., so that unequaled facilities were at hand in this most remarkable study of the human voice and its fluctuations.

In the present instance the investigator decided that, knowing exactly the particular curve corresponding to each letter of the alphabet, when uttered by any person regardless of age or sex, he would do very well to perfect or design a machine which would trace out exactly these differ-

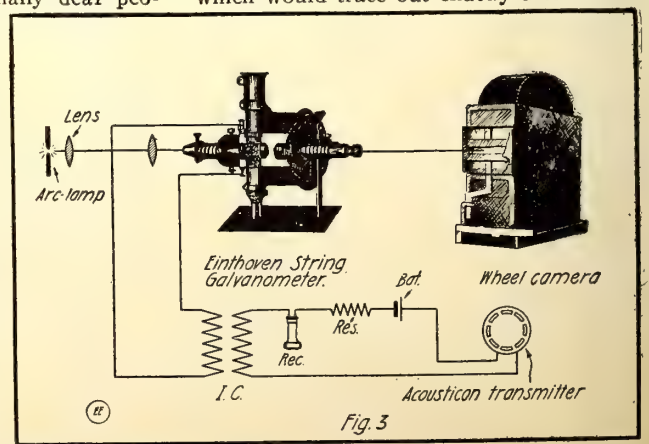


Fig. 3. Using an Einthoven String Galvanometer and Special Camera to Photograph Whispered Speech.

ent curves if *anyone should speak to it.* Accordingly, he has evolved a scheme as perceived at Fig. 5. This machine, it should be said at the start, utilizes a stylus or pen which writes or traces out the curves as shown in the phonetic alphabet at Fig. 4, corresponding to each letter of the English alphabet. Hence, if this was to be used commercially or otherwise, it would be necessary for those making use of such a "phonoscribe" (if we may so term this device), to learn this alphabet or else to employ a transcriber who could read it. Needless to say, it could be easily memorized, just as the notes of a musical composition are or the characteristic sounds of the letters employed in the study of foreign languages.

The voice-controlled phonetic typewriter as here outlined makes use of a selenium cell, which cell has a blank space at the center of its face. Ordinarily the beam of light caused to strike this cell rests on this blank spot. In operation a person speaks into the telephone transmitter or microphone and any current undulations thus set up in its circuit are prevented from reaching the stylus mechanism by the choke coils inserted between the batteries and microphone. Hence the current variations produced by the microphone, when spoken into, will proceed to the series of tuned circuits employing different values of inductances and capacity and arranged in the segment of a circle, as observed. These tuned circuits include a specially tuned resonator of the magnetic type. This comprises a pair of electromagnets in front of which is mounted a tuned magnetic strip, as indicated at Fig. 6. This resonator, which is tuned for any one tone of speech at any instant will therefore respond, likewise the current existing in it at any moment will vary in strength according to the speech variations at the microphone. Thus when the proper resonator responds to the corresponding letter sound the magnetic strip will vibrate powerfully, which will cause the connecting rod shown in Fig. 6 to oscillate the delicate shaft there shown. The connecting rod is secured to the shaft only .004 of an inch from the center line of same. It is thus possible to create an angular motion of the shaft of 1½ degrees when the magnetic strip has a given motion of but .0001 of an inch. Furthermore, a mirror attached to the shaft will move or oscillate with it, causing a beam of light from a tungsten or arc lamp (as indicated in Fig. 5, and passed through a series of

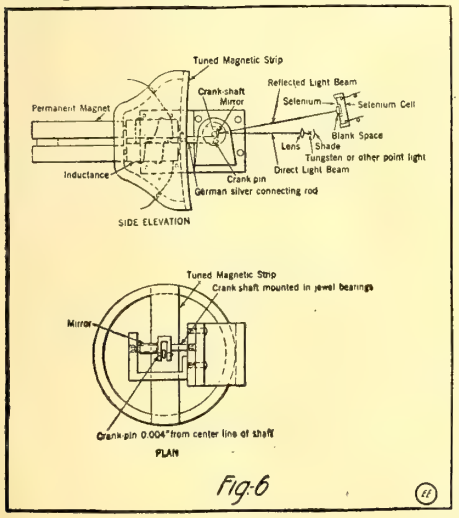


Fig. 6. Details of Tuned Magnetic Resonator and Reflecting Mirror.

lenses) to be reflected on the selenium cell aforementioned.

As stated, normally the spot of light rests at the center or on the blank space on the face of the selenium cell. When the reflected beam of light begins to oscillate it swings back and forth past this central dividing space and both halves of the cell are lighted proportionately to the amount of current energizing the electromagnetic resonator. When this occurs the selenium cell lowers its resistance in the well-known manner, and in turn this varies the amount of current passing through the electro magnetic solenoid, controlling the stylus which *traces the phonetic alphabet curves* on a revolving cylinder or drum. It may not seem possible that such a machine as this would write down or copy ordinary words, but such is the case, according to researches conducted by the inventor. This is so, he claims, because in uttering a *word* the sounds corresponding to the letters in the make-up occur consecutively, the recording pen of the "phonoscribe" thus writing out in a continuous line the connected sounds, as it were, of each letter in the word.

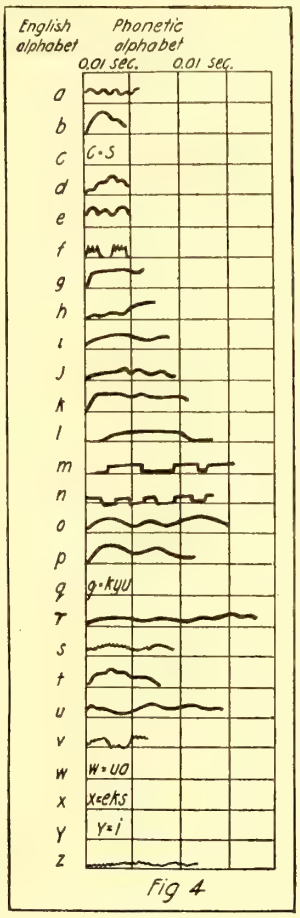


Fig. 4. The New Phonetic Alphabet Evolved by Mr. Flowers.

NEW USES FOR TELEPHONES.

Further experimentation on the loud-speaking telephone for railway train dispatching work has resulted in a loud speaker that is an unusual combination of distinct enunciation and large volume. A number of these instruments have been installed during the year on many of the lines of important railroad systems, where they are doing efficient work.

A new type of hand telephone has been developed in collaboration with the United States Forest Service for use in forest service patrol work. This hand set is a complete local battery telephone set which weighs only 2¾ pounds, making it the lightest satisfactory portable local battery set obtainable. The omission of a hand generator makes this possible.

Signaling of other stations on the line is done with an interrupter mechanism which operates a howler, connected at the permanent station, in addition to the regular bell of the stationary telephone. It is possible with this equipment to send a howl over a longer line. The hand set consists of a transmitter, receiver, induction coil, battery, signaling interrupter and talking and signaling push buttons.

GASOLINE-ELECTRIC TRACTORS HELP CLEAN NEW YORK CITY STREETS.

For some time past the New York Street Cleaning Department has been trying out various tractor and trailer combinations for the collection of ashes, garbage and street sweepings, as well as for mechanical sweeping and flushing of streets. The experience gained in this experimental work showed that while the electric tractor was highly desirable from the standpoint of operating simplicity the mileage limitation imposed by the storage battery equipment was a handicap. Further, that because of the many stops in collection work (60 to 100 per hour) the gasoline tractor with gear transmission clutch, spark and throttle control was not only impractical, but presented the disadvantage of greater complication, with the resulting necessity for a higher class of drivers.

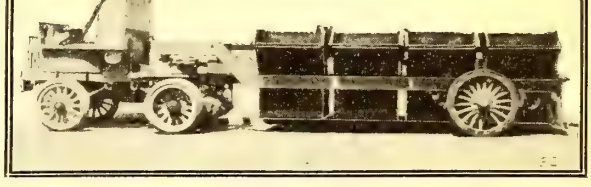
It has long been appreciated that the real work of street cleaning and flushing must be done at night, and the collection of refuse during the day. This calls for at least 16 hours service in 24.

A type of tractor which would be capable of practically continuous operation and adaptable to either kind of service was evidently necessary. A tractor equipped with a gasoline engine driving an electric generator, whose output could be used in motors driving the rear wheels, was accordingly chosen as having the simplicity of control of an electric vehicle and the relatively large mileage capacity of "straight" gasoline equipment. This combination also presented the advantage of providing in the most convenient form energy for driving the auxiliary apparatus used in street sweeping and flushing.

Twelve such tractors are now in use by the Department of Street Cleaning in this city.

The electric motors are suspended by links from extensions of the rear spring hangers and by extensions of their cases which bear on the rear axle. The motors drive by spur gears to intermediate shafts, which carry pinions engaging with internal ring gears mounted on the rear wheels. The use of pressed fabric pinions on the motor shafts has resulted in extremely quiet operation. The motors themselves are, except for the special cases, of the standard automobile type with ball bearings.

A 40-horsepower gasoline engine was thought to be a proper selection. The engine used in the tractors is a four-cylinder type. A centrifugal governor maintains a rotative speed of 900 r. p. m., this latter being the rated speed of the electric generator.



Gasoline Electric Tractors Clean New York City Streets.

The generator is rated at 15 kilowatts, 125 volts, 120 amperes at 900 r. p. m. The electric wiring is all carried in metal conduit, and the controller, cut-out switch and ignition switch are placed in a sheet-steel box beneath the driver's seat.

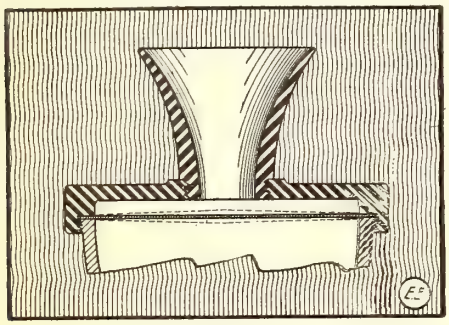
In Zurich, Switzerland, street cars are run by liquid air.

How to Talk Into the Telephone

By Robert W. Phelps

"HELLO! Hello! Hello; can't hear you. Talk louder, please!"

How often do you say this when you cannot understand the party on the other end of the telephone? The party on the other end of the line raises his voice and yet the voice sounds as if from afar.



This diagram of the mouthpiece of a telephone transmitter illustrates how the diaphragm vibrates. The greater the intensity of the voice the greater the intensity of vibrations of the diaphragm and the electric impulses sent over the wires.

You shake up the telephone transmitter and he does the same. Sometimes this obviates the trouble and sometimes it does not.

Possibly you frequently converse with a party with whom you invariably experience difficulty in hearing his voice plainly through the 'phone. You know that this party usually talks directly into the mouthpiece of the transmitter so loud that he can be heard for several rooms about, and yet his voice sounds very faint at your end of the telephone.

Possibly you also talk with another party who sends every word through the telephone as clear as if he were speaking directly into your ear. And, further, you have seen him using a telephone, speaking in a low tone that was hardly audible 10 feet away. Why is one party so plainly heard, speaking with but little effort, and the other with so much difficulty?

A little knowledge of sound and its application in telephoning will save much annoyance in telephone conversation, as well as do away with much unjust condemnation of telephone companies for poor service.

Sound is the impression produced on the ear by the vibrations of an elastic medium, such as air. Such vibrations radiating from a source are spoken of as *sound waves*. Sound waves travel in air at the rate of about 1,100 feet per second. The length of the wave determines the pitch of the sound. That is, the greater the number of waves striking the ear per second, the higher the pitch. The height, or amplitude, of the wave determines the intensity or loudness of the sound. At the point at which the sound originates the intensity is the greatest, and its intensity decreases as the wave travels. The velocity remains the same from the time the wave starts until the intensity becomes nil.

Each note on the musical scale has a definite number of vibrations per second. As an example, middle c, designated as c′ in the accompanying musical scales, has 256 vibrations per second. The note one octave higher, designated as c″, has 512, just twice as many as middle c. The note c, one octave lower than middle c, has but 126 vibrations per second, or one-half the number of middle c.

In general the number of vibrations per second are doubled when the pitch of sound is raised one octave.

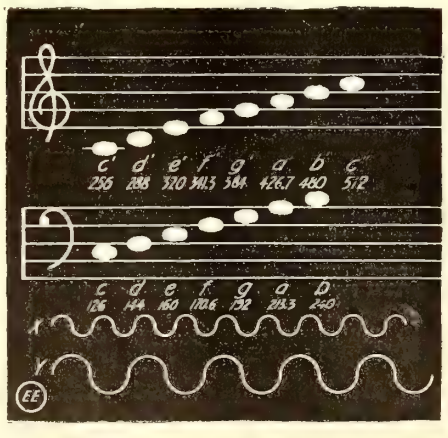
Ordinarily the higher the pitch of sound, the less the amplitude of the wave. When the higher notes have the same intensity as the lower notes they become shrill and unpleasant to the ear. It will be noticed that when a soprano singer reaches for the higher notes, the tone is more pleasing to the ear when not sung loudly. How different with the basso.

Now let us glance at the diagram illustrating the propagation of two sound waves for the same length of time, but one having a pitch of one octave higher than the other. In the same length of time the higher pitch has twice the number of vibrations as the lower. In tones of the same quality the intensity of the waves X is about one-half that of waves Y.

When these waves strike the diaphragm of the telephone transmitter the higher pitch causes the diaphragm to vibrate with twice the rapidity of the one an octave lower in pitch. The higher pitch does not cause it to vibrate with the intensity of the lower pitch, for two reasons. The first is, that the wave of the higher pitch does not have the amplitude of the wave of the lower pitch. The second reason, which is probably the more important, is that each vibration of equal intensity of the diaphragm absorbs about the same amount of energy. Therefore the diaphragm absorbs twice the energy to overcome its inertia, when vibrating in the higher octave, than it does when vibrating in the lower octave.

It should be kept in mind that there are two diaphragms in a telephone instrument —one in the transmitter and one in the receiver.

With the above knowledge of the rudiments of sound and its application to the use of the telephone, the natural conclusion is that the lower the pitch of the voice at the transmitter the more audible will it be at the receiver of the telephone. When not understood over the 'phone, one should, therefore, lower the voice, rather than allow it to rise to a higher pitch. Try it the next time you use a telephone and watch the results.



Every note on the musical scale has a definite number of vibrations per second, as indicated above. It makes no difference how loud or how soft middle "c" is sung, it always has 256 vibrations per second. Each octave difference in pitch, going up the scale, doubles the number of vibrations per second.

The two lower curved lines represent sound waves having a difference of one octave in pitch, but of the same quality. The upper wave is the higher pitch.

YOU CAN PHONE THE CHEF NOW

"Hello! Give me one 602, a little 312, two 874 and a cup of 302."

No, these are not the signals of a football quarterback; they are simply the indications of a fairly good appetite as expressed over the special restaurant telephone system installed by the Ritz Co., which runs a lunch room in Plainfield, N. J. Instead of using waiters to take patrons' orders, the company has equipped its restaurant with telephones. One of them *waits* patiently at every table. The



"'Phone the Chef," the latest fad in restaurant novelties.

lines from these tables are connected with the kitchen.

The operation of the system is simple. When the patron takes his seat at the table he studies a menu whose dishes are indicated by numbers. When he has made his selection he picks up his telephone and gives his symbolic order to the chef.

Photo courtesy of Western Electric Co.

"PAUL REVERE" VIA RADIO.

The preparedness and skill of the 25,,000 licensed amateur wireless operators of the United States was tested by Uncle Sam on Feb. 21, when a message appropriate to the celebration of Washington's Birthday was sent to William H. Kirkwin at the licensed station "9XE" for transmission throughout the country. The message, which was dispatched at 11 o'clock, was picked up by all stations within 300 miles of Davenport and relayed in every direction for transmission to the governors of each State and the mayors of the principal cities. The message read as follows:

"A democracy requires that a people who govern and educate themselves should be so armed and disciplined that they can protect themselves.

"COL. NICHOLSON, U. S. A."

The message was read by boy scouts at Mount Vernon and at Bunker Hill.

The wireless message urging preparedness was duly received in Washington and delivered to the policeman who stood on guard at the White House office at 2 o'clock in the morning. He delivered the message to Secretary Tumulty for presentation to the President.

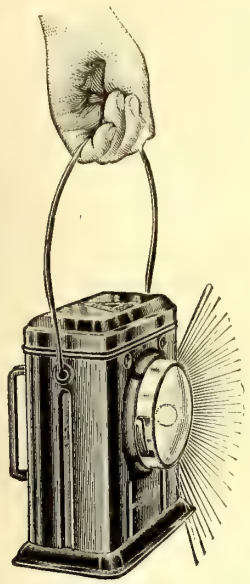
On account of the number of relays, it required about an hour and a half to send the message from Davenport to the Pacific Coast, more than 2,000 miles from its starting point.

The message was characterized by some of those interested as "Paul Revere's ride done into wireless," as with the changing of the words it might have been utilized to call a nation to arms, much as Paul Revere called the Minute Men.

A surgeon in the Japanese army is reported to have invented a machine run by electricity that grinds as many beans into flour in 40 minutes as a man can grind by hand in a day.

NEW TWO-CELL ELECTRIC LANTERN.

A very practical and useful design of an electric lantern has recently been developed by an enterprising concern; it is designed to accommodate two standard dry cells instead of one. This of course gives much



New Electric Lantern Uses Two Standard Dry Cells.

greater life to the lamp for a given candlepower, and also a larger bulb than that adapted to the single-cell style of lantern may be used.

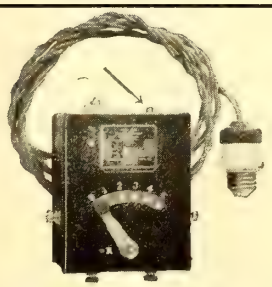
The case is made from a steel shell which acts as a container for the batteries, and the bulb supplied with it is of the tungsten type with an efficiency of about 1 watt per candlepower. The lamp is fitted with a 3¼-inch silver-plated reflector, designed to throw a well-diffused light over an arc of 180 degrees, but especially concentrated beam reflectors can be furnished if desired by the purchaser.

A powerful concave-convex lens 3¼ inches in diameter is fitted in front of the reflector and tungsten lamp.

The case is neatly finished in baked black enamel with trimmings of polished nickel. The manufacturers of this latest type electric lantern for the utilization of dry cells claim that it gives steady service and it sells for a very nominal price commensurate with the high quality of the workmanship and materials involved in its construction.

NEW TOY TRANSFORMER HAS CIRCUIT BREAKER ON IT.

A progressive manufacturer of toy step-down transformers suitable for reducing 110-volt, alternating current lighting cur-



This Toy Transformer Has a Circuit Breaker on It.

rent for running toy railways, etc., has at last developed an important detail on this much-used device, which promises to be a boon to those making use of such apparatus. This improvement is in the form of an automatic circuit breaker which opens the primary circuit of the transformer; i. e., it disconnects the 110-volt current whenever the secondary of the transformer is overloaded, such as by a short-circuited section of toy railway track, etc. The circuit breaker will continue to trip open, no matter how often it is reset, so long as the short-circuit exists across the secondary of the transformer. The illustration herewith shows the appearance of this attachment and the transformer complete. The circuit breaker is reset by means of a small push button, to which the arrow points. The secondary is adjustable for different voltages by means of a switch, as observed, and undoubtedly this innovation will be highly appreciated by those having to make use of this important piece of apparatus, which is much in demand for operating small battery motors, toy railways, low-voltage lamps and other miscellaneous toys and devices.

BATTLE CREEK, MICH., HIGH SCHOOL WIRELESS CLUB.

The High School Wireless Club resumed activities with the opening of school in entirely new quarters. The operating room has been moved from the physics laboratory in the basement to the observation dome at the top of the building, and the work of reinstalling the instruments and wiring recently completed makes this one of the best sets in the State.

Forest Phippany, Dale Ball and other members of the club at the high school building for some time preparatory to the change, and they now have things in shape for a busy season.

The European war and recent ocean disasters have aroused a keen interest in the wireless telegraph and there are a dozen stations in Battle Creek now. A number of the members of the high school club have stations at their homes. The high school station and many of the others here catch messages from Arlington, Va., and other far-away points, and have a sending radius of from 100 to 200 miles.

With the wireless room in the dome of the building, away from the noise and confusion from the streets and corridors, it is thought that the efficiency and range of the station will be greatly increased. A number of new parts have been installed and the old sending and receiving apparatus, which is standard in every particular, has been completely overhauled.

AN ELECTRIC FOUNTAIN.

It is often desirable to complete the decoration of a room or restaurant in an attractive manner by utilizing a small fountain, but until quite recently this was impossible on account of the numerous pipes necessary to conduct the water supply to and away from the fountain.

The only natural solution of this problem lies in using the same water over and over. To accomplish this end the fountain here illustrated has been brought out.

This beautiful display may be placed in any position, anywhere, and requires nothing but a cord connection to the nearest electric light socket in order to continue its action indefinitely, or as long as the current is turned on.

The base of the apparatus contains a motor-driven pump which forces the water up through the several jets surrounding the figure, as observed. The water then falls back into the large basin around the



Electric Fountains Are Now Available in All Sizes for Parlor or Dining Room Decorations.

foot of the figure and flows to the pump again, only to continue the same cycle. The water is prevented from splashing by means of this large basin, specially designed.

The design here pictured measures 24 inches from the top of the figure to the base, which is 15 by 12 inches. The jets of water reach a height of 30 inches, which is sufficiently high for use in a conservatory or a large room when the fountain is placed on the floor.

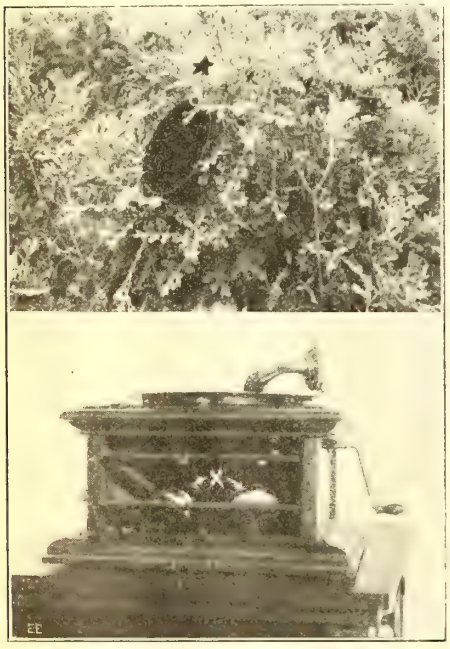
The motor operates on either an alternating or direct current circuit. The current consumed is very small; the actual cost of operating the fountain is about 1 cent per hour. The apparatus will last indefinitely and should prove a real asset around country homes or hotels. There is nothing more beautiful or ornate than a water fountain for interior decorations, dinner spreads, balls, parties.

A MUSICAL GARDEN WALL.

By Albert Marple.

A loud-talking telephone is one of the most recent electrical inventions of Earl C. Hanson, the 22-year-old inventor of sunny Los Angeles. The function of this loud-talking device is to take the sound of the human voice or the music from a phonograph or other instrument and multiply it as many times as desired. This effect is secured by means of an amplifier, which after several years of hard work has been highly perfected by this young inventor. The extent to which the sound may be multiplied is governed only by the amount of electrical energy employed.

The work of this instrument may be more definitely understood if the description of a recent test is given. Incidentally, it may be stated that this instrument has been given a number of try-outs recently in and around the city of Los Angeles, and wherever the wonders of the device have been heard the instrument has proven a sensation. The principal demonstration was held at the country home of one of the most prominent judges in southern California. On this occasion the "central station" was the music room in the beautiful



Above: Loud Talking Telephone Placed in Garden Shrubbery. Below: Cross Indicates Amplifier Microphones Placed in Phonograph.

dwelling, and the receiving stations were located at various points throughout the grounds surrounding the home. The moment the phonograph in the music room was started the gardens, several hundred acres in extent, were filled with sweet melodies, grand opera arias, popular selections and instrumental pieces, following one another in rapid succession.

Over all parts of the garden the music could be heard just as distinctly as could the phonograph at the central station. In the garden this music seemed to come from a beautiful border hedge, at another point it seemed to drift from a mammoth rose vine, while at another point the music waves seemed to come from the wide-spreading branches of a beautiful pepper tree. The telephonic receiving stations were hidden from the view of those in the garden, and to each receiver was attached a small megaphone. As the ranges of sound from the various receiving stations overlapped it seemed for all the world as though the very universe was filled with music.

It is not claimed by Mr. Hanson that this is the first time that phonograph music has been transmitted over the telephone, but he does declare that he has invented an amplifier which will increase any volume of sound many times.

The inventor believes that the field in which this new device could most profitably be used, in his opinion, is in connection with park concerts given by the municipality. For this work a "central station" could be located near the center of the city, with receiving stations at each of the public parks within the municipality's borders. At any given time during the day or evening a concert of phonograph selections played at the "central station" could be reproduced simultaneously at all of the parks within the system or circuit, the only expense to the municipality being for the employe who operates the phonograph.

With the exception of the amplifier there is nothing complicated about this "loud-talking" system. It is of ordinary telephonic construction. The music from the phonograph is played into one or more regular telephone transmitters. From these transmitters (marked X in photograph) it is carried by wire to the amplifier, which intensifies it as greatly as desired. From this instrument the sound, greatly augmented in volume, is carried over a double wire to the various receiving stations.

There is another feature about this apparatus or system which is of interest. When operated from the receiver to the transmitter ends it has the effect of a "dictagraph." While for those sentimentally inclined music in cozy corners and nooks is admirable, a disadvantage with the machine is that it would be dangerous for lovers to whisper "sweet nothings" nonchalantly, for the slightest sound is carried back to the "central station," where it is amplified and may be distinctly heard by the operator.

WIRELESS KILLS WOMAN.

Wires from an amateur radio telegraph apparatus sagging down and coming in contact with a live wire of an electric light plant recently killed Mary Roskinsky, a servant, employed in the family of Chas. Abrams, living at 518 Fourth avenue, Astoria, L. I. The wireless apparatus belonged to Mr. Abrams's son, Herbert Abrams, 18 years old.

He had an apparatus run by dry batteries set up on a small table in his bedroom in the rear of the second floor. The victim's right hand grasped the key of the instrument while her left hand clutched one of the wires which had been grounded on the steam radiator within one or two feet of the table.

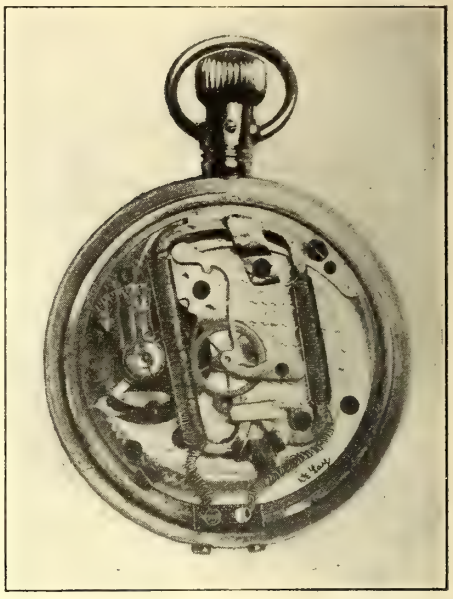
The police found that the boy, in equipping his plant, had run his aerials out of the back window of his bedroom from the rear of his house for a distance of about 100 feet. During a recent storm the wires were weighted down by snow and became slack, so that in a light wind they occasionally knocked against a primary wire of the New York & Queens Electric Light Co. which was carrying 2,400 volts. Just why the girl caught hold of the key of the wireless apparatus is not known, but it is thought she probably started in to clean around the table and was in the act of moving it when the aerial wire sagged down and came in contact with the heavy feed wire below. In the shock she suffered the table upset and she was killed.

AUTOMATIC 'PHONE USED IN NORWAY.

The Norwegian Government is planning for an automatic telephone exchange in Christiania, and the first of the kind in Norway.

SPEED COUNTER AND STOP-WATCH ELECTRICALLY CONTROLLED.

An extremely useful device in the line of stop-watches and speed counters, which are widely used by engineers, machinists and others, is incorporated in the electrically



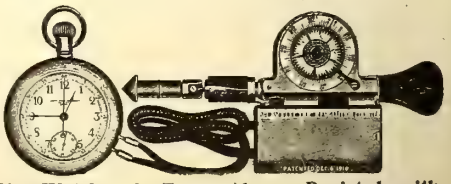
Electro-Magnets Accurately Control This Stop-Watch.

manipulated stop-watch perfected by Frederick A. De Lay.

The illustration herewith shows the interior mechanism of this electrically operated stop-watch. A small electro-magnet is mounted on the regular movement of same, as perceived. It is so arranged that the sweep hand engages when the circuit is open and becomes disengaged when the circuit is closed. This particular arrangement and refinement permits of very accurate timing of any operation in which the starting and stopping action can be made to open and close the circuit of the electro-magnet.

When this unique electric stop-watch is used with a revolution counter they are interconnected electrically, so that as the counter dial starts to turn the electrical circuit hooked up to the stop-watch is automatically opened and thus permitted to start same. The watch and counter automatically stop at the same time, since stopping the counter's shaft again closes the electro-magnet's circuit, which includes a small flashlight battery contained in the metal case attached to the counter. It is understood that the electro-magnetic attachment here devised does not interfere in any way with the use of the watch as a time-keeper or as a manually operated stop-watch.

The cost of this outfit is quite nominal



Stop-Watch of Type Above Depicted with Speed Counter and Electric Circuit Controller for Same.

and it should appeal to electricians, machinists, inspectors and others who have to do with the testing of any machinery, and, besides, there are many diversified applications to which this ingenious and accurate timing arrangement can be adapted, as, for instance, the timing of horse and foot races, train velocities, et cetera.

Timing Your Telephone Speech

By Frank C. Perkins

The accompanying illustration shows the use of a novel form of meter recently developed for timing long distance and toll telephone calls. It is pointed out that time and money are lost because of inadequate means of checking toll calls. An instance is given below:

A Philadelphia genius called at the office



Unique "Minute Timer" for Telephone Users. Especially Valuable on Long-Distance Calls.

of a business friend and found him engaged in a long-distance conversation with a factory manager. The business man rang off and turning to his visitor, said:

"Three minutes is not time enough for a long-distance call. I must concentrate my message into a very few words or else pay for excess time."

A few minutes later a salesman in Boston was on the wire. The visitor timed the conversation. It consumed a minute and a quarter. This business man, therefore, paid for six minutes of service, but used less than three minutes. This occasioned an actual loss of $2.50.

A careful investigation has conclusively proven that only about 46 per cent. of the time paid for is actually used. The balance is pure waste, which means a real monetary loss to American business—amounting, in fact, to more than $60,000,000 a year.

Whether one uses the long-distance service much or little, there is this waste. It is one of the few leaks in modern business that has not been checked. It became evident that there was a real need for a simple, yet effective, device for timing long-distance calls and increasing the telephone efficiency of business men.

The "phone-meter," here illustrated, is a neat little clocklike device, with a single hand and a specially designed dial. It is so simple and inexpensive that at first glance one can scarcely perhaps appreciate its great utility.

It will be seen that the "phone-meter" is a check on the person using the 'phone, rather than on the telephone company—yet it does both. It enables one to use all the time paid for, and one can more readily concentrate the mind on the message, instead of thinking about possible excess charges. It enables one to talk more leisurely and often do a little "visiting" over the wire after finishing a business message.

This instrument is also a check on interruptions, as it enables one to stop the time until the connection is restored. If the operator knows that one has a "phone-meter" she will not charge for the loss of time resulting from broken connections. The lost time on two or three calls often amounts to more than the price of the instrument.

WORLD-WIDE RADIO 'PHONE.

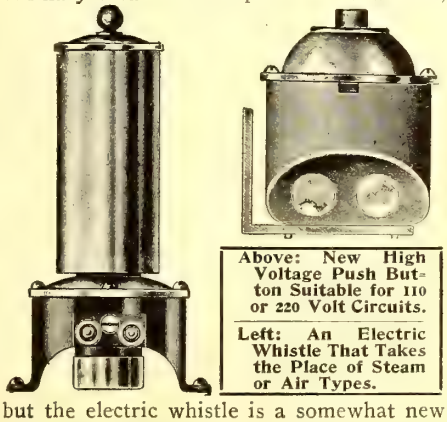
Wireless telephony will soon extend around the world, Secretary of the Navy Daniels told guests at a banquet given at the Lotos Club recently in honor of John J. Carty, who has succeeded in extending the uses of the wireless telephone.

"We thought until recently that wireless telegraphy was the last of modern miracles that had to do with communication," said Secretary Daniels. "Recently the world was amazed when from Washington, without wires, the human voice was heard in San Francisco. When fully perfected, we may talk to our friends 'from Greenland's icy mountains to India's coral strands.' The man whose genius is making this miracle possible is Mr. Carty."

At the banquet table were telephones connecting with the wireless stations at San Francisco and elsewhere.

NEW ELECTRIC WHISTLE AND HIGH VOLTAGE PUSH BUTTON.

Most every one has heard and seen the ordinary steam or compressed air whistle,



Above: New High Voltage Push Button Suitable for 110 or 220 Volt Circuits.

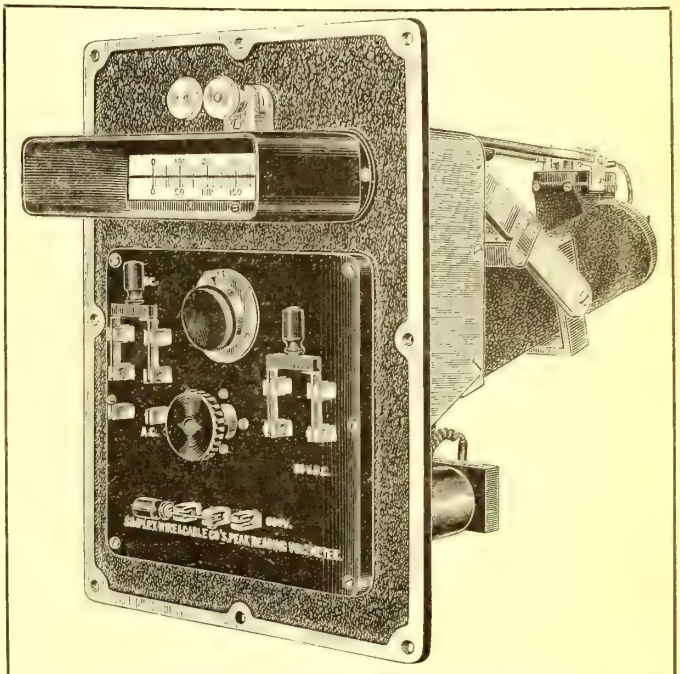
Left: An Electric Whistle That Takes the Place of Steam or Air Types.

but the electric whistle is a somewhat new device, so it seems. The illustration herewith shows one of these perfected devices, which operates on either 110 volt or 220 volt a.c. circuit, or from a 10-volt battery circuit. These whistles operate on the principle of a vibrating diaphragm.

To control such devices as this is naturally beyond the province of the ordinary push buttons used for bell circuits and the like, so a special type of high voltage push button, shown in the second illustration, was perfected. This button is practically the same size as the ordinary bell push. In the illustration it is shown fitted onto a special conduit box designed for use with it. These buttons may be used for operating 110 or 220 volt circuits controlling horns, bells, lights, elevator systems, motor control circuits, etc.

A PEAK READING VOLTMETER.

One of the leading American manufacturers of electrical measuring instruments has recently brought forth what is termed "a peak reading voltmeter." This instrument has been in great demand in the past and will undoubtedly find considerable adoption in the future. This meter affords a practical means for determining the *maximum voltage* on any alternating current system, reading the potential direct and always independent of the form of the wave, besides indicating the maximum voltage at all times.



A "Peak" Reading Voltmeter That Registers the Maximum Voltage of Alternating Current, Besides Indicating Variations in These Values.

As the meter also shows variations of the maximum voltage, it serves as an indicator of distortion of the wave form. It was particularly developed for use in connection with high tension cable testing, where, due to the capacity load, distortion of the wave is very likely to occur. It is, however, applicable to any alternating current apparatus or system, where a quick and accurate knowledge of the maximum voltage value is required.

In contradistinction to the ordinary voltmeter, this instrument reads the highest voltage attained by any wave of commercial frequency, while the instruments generally used for measuring alternating current potentials indicate the *effective value* which, of course, is about 30 per cent. less than the maximum or peak voltage of the current passing through the circuit. The common 110-volt a.c. lighting circuit, for example, has a maximum peak potential of about 155 volts.

The "Live Wire"

By Adelbert H. Wolfe

Read This Article on the Live Wire. It Explains How the Current Traverses a Conductor by Electronic Vibration

THE term live wire is often mentioned in speaking of high potential circuits.

There seems to be a mysterious phenomena surrounding it which impresses one of its importance. It is always considered as something dangerous to come in contact with, as it will severely burn, and if the amperage is sufficiently high will cause death to animal life. Let us consider this wire that possesses these dangerous and death-dealing qualities, and which will, if more current is added, melt, consume itself, and go up in smoke. The question is, how does this wire differ from any other wire lying around? Of course, you would readily answer that the above mentioned live wire is connected into a circuit, which is supplied with sufficient amperage and voltage to bring it to that high temperature in which it turns to molten metal.

Let us endeavor to learn more about this mysterious phenomena by taking for an example a battery, key and sufficient wire to complete the circuit, Fig. 1.

When the key K is depressed we know that current flows from the positive plate of the battery A, through B and down to the key K, passing through its points and back to the negative plate C of the battery. It was mentioned that current flowed from the positive to the negative plate in the external circuit, as that is the theory most generally used. But the writer feels safe to say that current not only flows from positive to negative in the external circuit, but also vice versa, or from negative to positive. The writer will take this up further in another part of this article.

Before we go any further let us refer again to Fig. 1 and answer a couple of questions.

1st. What is the condition of the open circuit before the key is depressed?

2d. What is the condition of the closed circuit after the key is depressed?

The above questions we will have to answer before we can determine what there is in the wire to make it heat.

In taking up question 1 let us first get at the bottom of the phenomena of electricity flowing through a wire. We know in the first place that everything material consists of molecules and atoms. The writer would like to make this article as simple as possible and deal only with molecules, but in dealing with current flow there is something else which we must take into consideration, and that is the electron. This very tiny germ of physical force is comparatively at home among the atoms and molecules of all metals and most liquids. It can easily penetrate a molecule and pass around through its atomic structure, tearing off a piece of an atom here and there. These tiny agents, the electrons, have the whole responsibility of transmitting the electric charges in a wire to their destination so far as we know. They are the electric charges themselves, and without them we would not have any electric current. They are the seat of current flow, that is, a positive particle is repelled by its positive neighbor and attracted by its negative one.

In case of question 1. When A B is connected to positive plate A and the circuit is open at K we need not think for an instant that the positive charges in the plate A of the battery remain there. No, as quick as contact is made, they rush out through the new road of molecules and atoms seeking a way of escape, only to come at rest when the whole portion of the circuit from A to K is occupied.

Referring to Fig. 2 we have shown a portion of the circuit on a large scale; K represents the key points, C and A the negative and positive sides of the circuit, respectively. In C it will be noticed that the molecules nearest K are more darkly shaded. This represents a greater density of the negative electrons at that point. The same will be noticed in A, only that the shading is reversed, the white molecules denoting where the positive particles are dense. This massing of the positive and negative charges at K is practically true. It is similar to the massing of the "lines of force" at the poles of a magnet. The reader understands that the above movement of the charges is not current flow. But in case of A, Fig. 1, it is simply the positive forces lining up ready to rush into the negative neighborhood just across the key points. The same holds true for the negative side C.

Therefore in answer to question 1 we can say that the portions of the open circuit A B K and K C are seats of potential energy, each having, respectively, their positive and negative forces massed together, but held in check ready to launch themselves into each other at the touch of the key. It is understood that if the voltage was sufficiently high the key points would be bridged and the conditions of the circuit would be the same as if the key had been depressed.

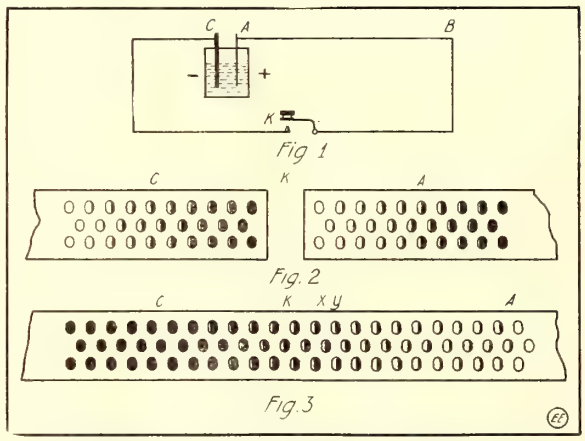


Diagram Indicating How Electrons in a Conductor Communicate a Charge from One Molecule to the Next at the Marvelous Velocity of 186,000 Miles Per Second.

In case of question 2, the moment that contact is made the positive and negative forces that are waiting in the form of potential energy change places; the velocity of the flying forces is truly enormous. Fig. 3 shows K closed. At this instant the opposite forces that are nearest K intermingle, as is shown in the figure directly below K. In this section of the wire it will be seen that the molecules contain equal plus and minus charges. The negative half of the molecules charge is traveling in full force toward A, while the positive half is likewise traveling toward C. It is understood that the molecules are not moving, but the electrons in them. The latter use the molecules for stepping stones, jumping from one to the other in their mad rush back to their home battery plates.

Take for an example the molecules x y, Fig. 3. The negative charge in Y was formerly in X, as also the positive charge in X was formerly in Y. This is how the forces travel through the wire, each force borrowing from the molecule ahead of it an equal quantity of the force of the unlike sign and replacing it with itself. Thus it keeps on this free exchange until it reaches the battery plate, where it is acted upon by the chemical solution. Or in the case of a dynamo being the source of energy it finds its way back to the original armature coil from which it started.

In the above movement of tiny electron the combined movement, which we call an electric current, the molecules of the medium through which they pass, whether it be metal, earth or water, are not practically displaced, but it is their atomic structure that is in turmoil, and as the amperage increases the greater the decomposition of the atoms will be. Also the more molecules are set into vibration.

Therefore in answer to question 2 we can say that after the key is depressed the structure of the wire experiences a molecular upheaval, as the tiny electrons or forces surge through its atomic structure decomposing them and giving to the wire, shall we call it, frictional heat.

* * * * * * *

It has taken years of experimenting to bring the live wire up to its present perfection. The great achievement of transcontinental talk over a telephone wire has been perfected. But taking it altogether the wire is nearing the end of its victorious life.

It has climbed, rung by rung, up the ladder of invention and fame and deserves a good share of the glory in the electrical field. For without it all the great electrical inventions would have been impossible. For example, without the electro-magnet there would never have been any dynamos, telephones or telegraphs. No, not even our wireless telegraph and telephones. These two latter inventions, which the wire has helped to bring about, have paradoxically dealt it the most telling death blow.

Since the trans-Atlantic radio telegraph and telephone are a fact, it no longer requires the "cables" that are lying on the ocean bed to spell out the message in Morse code. It is this new thing that man has invented, the "electro-static wave," that can cause the message to be transmitted across the water with the speed of light (186,000 miles per second).

It is this ethereal agent that is the wire's most deadly opponent. The "cable" is no longer required; it extent is reduced to the length of the wires in the "aerials" on either side of the ocean. This is the wire's one great defeat and others are soon to follow.

The wire must give place to the ether wave. The victory gained by the latter will be slow, but nevertheless will be complete in the end, as Nikola Tesla claims.

What wire used then on apparatus, if any, will be of such a small amount that it will become nearly, if not wholly, obsolete.

BRAZILIAN RADIO ACTIVITIES.

The Brazilian Government has decided to erect wireless telegraph stations in the Rio Grande do Sul Santa Catharina, Sao Thome, Cruziero do Sul, Senna Madureira, Rio Branco, Sao Luiz de Caceres and Porto Murtinho. Steps are being taken to organize a general scheme of radio telegraphy, both on the coast and in the interior.

Making Things

By Thomas Reed

DID your father ever tell you it "Doesn't pay to make anything yourself?" Mine used to. After watching me working like an ant to make a little whirly thing I could have bought for a dollar he casually figured up how much more quickly I could have earned that dollar by sawing wood, and bought the whirly thing. Did Rockefeller drill his own oil wells? No. He hired other people to do it. That's the way he got rich. But this tinkering idea of mine had no standing at all. Life was too short.

There was a little finesse in father's suggestion about the wood-sawing, because he wanted me to contract the wood-sawing habit; but apart from that his attitude was due to his being sore over a certain occasion when he took a hundred dollars out of himself trying to save five dollars. Rockefeller at that time was supposed to have made his fortune by not spending anything. Rockefeller theories keep changing, you know, just like atomic theories.

My father, good old man, never tried to make anything, or if he did nobody recognized it as such; but sometimes when he felt strong and had mused on Rockefeller, he would do a little repair-work around the house. I remember when he achieved his masterpiece in this line by mending a broken leg (on a chair, you know—he never dabbled in surgery).

Father had a very complete kit of tools, consisting of a hammer, a gimlet, a plane that got plugged up, and a baking powder can full of rusty screws; and there was a screwdriver in the sewing machine drawer, but that wasn't his, you bet it wasn't!

He retired to the cellar with the so-called tools, together with the chair, and we children kept out of the cellar because—well something in his manner told us he preferred it that way.

After a couple of evenings' hard labor he came up with the chair, and sure enough the leg was cleated on so it looked all right—though he said he guessed we had better not sit on it just yet. Evidently it was convalescing. He had broken his glasses, and his mind had got deeply peeved like a baby after a hard day at the beach. Mother had something she wanted to say to him when the children wa'nt round, about an expression that had escaped him inadvertently; and it did look from certain angles as though it would have been cheaper for father to buy a new chair, or go without and stand up.

But shucks, father, there is a joy in the sense of mastery when you accomplish a thing yourself which far out-weighs the paltry coin saved! (You understand I didn't really hand any such good counsel to father, I only thought it. The current of counsel in our family ran distinctly the other way. There was never any backwash to speak of.)

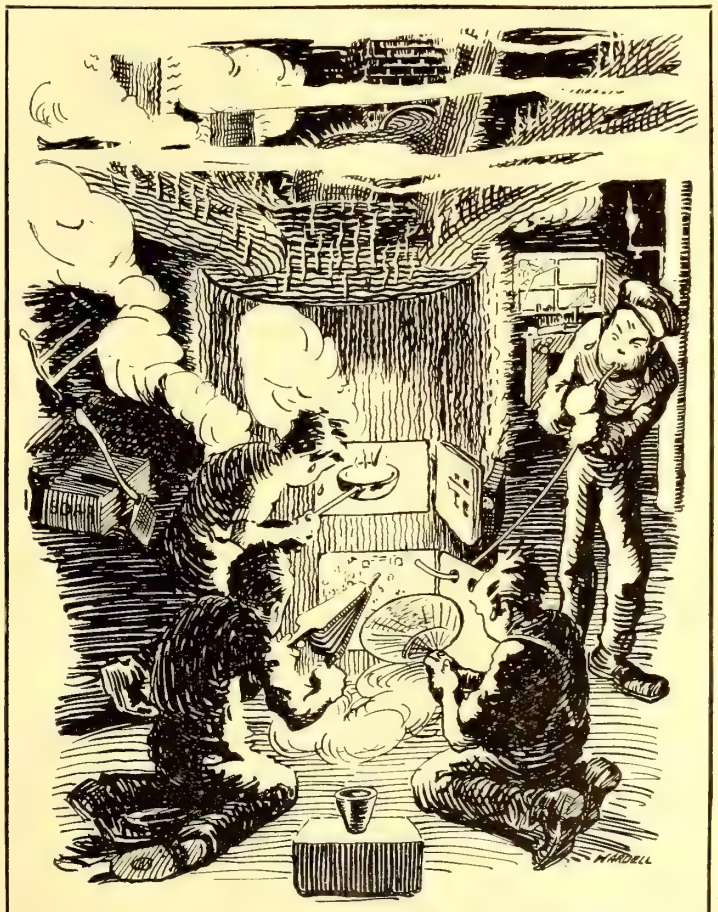
But whenever I got a good laugh (in my sleeve) on father he was sure to get it back on me before long. For sometimes in my early experiments the saving of my scanty hoard involved such a prodigious expenditure of energy that even to me the result seemed out of proportion—rather a small hang-out, as the fellow says, for so large a wash.

Long ago, when telegraph instruments were the correct thing in amateur circles, the Band of Young Edisons to which I belonged decided to put one over the neighboring bands by making up a real cast-brass set. We hung around the brass foundry and watched operations until we understood what we had to do, and then fell to with great secrecy, as this thing was to be sprung as a crushing surprise. We drew our designs from the pictures in the catalogs and sawed out the patterns with the jig-saw, giving them the slight taper necessary for drawing from the mould, and sandpapering and shellacking them smoothly. So far all was easy, and even the "flask" for holding the sand presented no difficulties. The fine moulding-sand we begged from the foundry-men, who by that time were glad to get rid of us at any price; and after a few trials we were able to draw the patterns and form the sprues.

Then loomed up the melting of the metal; and the enterprise reached that always ticklish stage when some of the settled habits of the family must for the moment give way to the requirements of science. We collected all the old brass and copper on the premises (including one kettle that was missed and formed the subject of an investigation later). This metal in a black-lead crucible was placed in the family furnace, tenderly covered with a fat live coal, and with a forced draft, produced by bellows, fans, and lungs, we gradually forced the heat to the melting-point. The melting-point of the brass I mean; our own was passed far back along the road.

It was in the middle of winter; but before the pouring took place every window in the house was open and the heavy underwear of the family upstairs was scratching just as it does in spring. At one stage somebody started for the fire-alarm box, but was headed off just in time. The output, on a general cooling (of metal, house and anxiety) were a dozen small castings plentifully sprinkled with case-hardened iron particles which defied the file. The costs, as computed that evening by father, who was good at figures, totalled something like $15. (Including coal and repairs to the furnace, but excluding the kettle, which had not at the moment been audited.)

But shucks! Hadn't we *made* the set? The satisfaction of making it was certainly worth more than a paltry $15. If you have the "how-to-make-it" bug, you'll readily appreciate this.



". . . and with a forced draft produced by bellows, fans and lungs, we gradually forced the heat to the melting point."

U. S. WIRELESS TO CIRCLE WORLD.

A final step toward linking the United States with its foreign possessions through a great chain of wireless stations was taken recently, when Secretary Daniels, of the navy, approved a contract with the Federal Telegraph Co., of San Francisco, for the equipment of the big radio stations now under construction at San Diego, Cal., Cavite, P. I., and Pearl Harbor, Hawaii.

Completion of these stations within the next year will pave the way for radio communication from Washington not only to the insular possessions, but to almost any point in the world where there may be a receiving plant.

Plans are now being prepared by the Navy Department to increase the power of the existing equipment at Tutuila and Guam, so as to make them a part of this world wireless chain. The intermediate stations at Boston, New Orleans, Point Loma, Chicago and Guantanamo already have been strengthened and are able to relay messages from ships at sea to Washington via the Arlington, Va., towers.

Further advancement in radio development will be made this year at Charleston, S. C., San Juan, Key West, Puget Sound, Cordova and Mare Island.

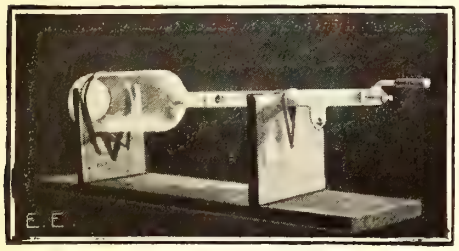
The new stations at Pearl Harbor and Cavite will be the most powerful in the world. They will be equipped with apparatus for exchanging messages over an area of approximately 4,700 miles, the greatest distance ever attained by radio plants in daily use. Each will maintain direct communication with San Diego, the Canal Zone and the Arlington stations, and will be able to sweep the Pacific Ocean from the Philippine Islands and to Alaska and the Canal Zone.

Use of the Braun-Tube for Research Work on Electric Oscillating Currents

By Prof. Dr. Ferdinand Braun, University of Strassburg i/Els.

*[By invitation of the editor of The Electrical Experimenter, I am pleased to give a short essay on the above mentioned subject.—Author.]**

I WILL begin with a few words on the *Cathodic Rays*. Suppose you have a glass tube in which the air is rarefied to the extent of that existent in the so-



Typical Form of Braun-Tube.

called Geissler tubes. An electric current passing through this tube will follow a path from the anode to the cathode, showing the well-known luminous effect. But if the gas is more and more rarefied this usual light effect disappears and the cathodic rays begin to develop themselves. They do not follow the path (if we may so term it) of the current, but are emitted from the cathode normally to its surface straight into the gas. The anode may be placed anywhere in the tube, one method being shown in Fig. 1. These rays impinge on the glass wall and produce an intense fluorescent light, which is usually green in color.

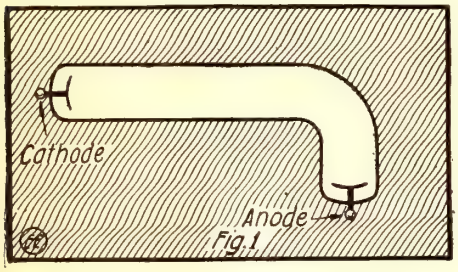


Fig. 1. Simple Cathode Ray Tube.

The cathode rays are streams of negatively charged particles (the electrons) flying through the vacuum with terrific velocity, this being between one-tenth to one-half and more of the velocity of the light (186,000 miles per second). These rays are practically without any inertia and represent electric currents in conductors; they are "flexible" in every direction. If you pass a cathodic ray between two metal plates (Fig. 2), one of which may be charged positively and the other negatively, the path of the cathode ray is changed in the electric field of the small condenser

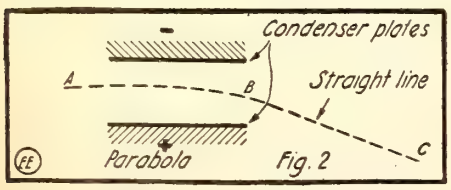


Fig. 2 Showing Deflection of Cathode Ray.

into the form of a parabola AB. After leaving this field it continues its way as a straight line BC. If the charge of the condenser varies periodically, the point C will oscillate in syntony with the time period of the charges. It produces in this manner an oscillating light point on the wall. This will be green and relatively weak on glass; blue and very much brighter on sulphide of calcium, and a very bright green on sulphide of zinc.

If the frequency of the charges varies at the rate of, say 100, the oscillations of the light point on a phosphorescent screen will also be 100; and if the frequency goes up to a thousand or a *hundred thousand,* the cathodic ray will *always follow and never lag.*

The effect of magnetic forces on this ray is the same as that on a current; the ray follows the magnetic force and is deflected in a direction perpendicular to such a force. Suppose you have a magnet coil, as Fig. 3, and pass an alternating current through it. If a cathodic ray lies in the field of the magnet it will be set in oscillation, according to the time period of the current.

The Braun-tube (Fig. 4) depends upon these properties, and can now be explained

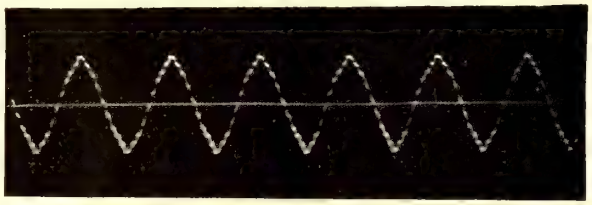


Fig. 6. Braun-Tube Oscillogram of 50 Cycle A. C. With Higher Harmonics.

in a few words. It should be called a cathodic ray tube, which is the term by which I introduced it into the scientific world, but as it was later called the Braun-tube I shall use this name for the sake of brevity.

Referring to Fig. 4, C is the cathode electrode, A is the anode and B is a small aperture made in a glass or metal diaphragm. As these materials do not allow cathodic rays to pass through, only a small stream of them pass through the opening, thus to create a "light image" on the fluorescent screen D. The tube is

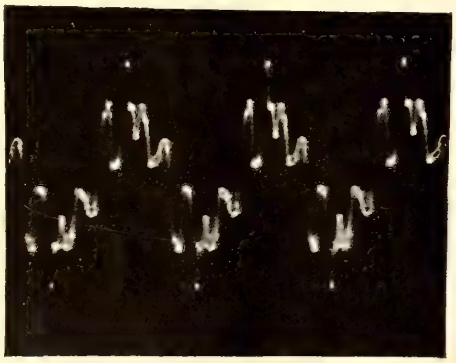


Fig. 7. Higher Harmonics of Fig. 6, Enlarged. N = 1,500.

evacuated to a high degree, and only by experiment can it be ascertained what the best degree of evacuation is. It can be estimated, however, by employing a spark gap placed parallel to the electrodes of the tube; a 2, 4 or 8 mm. spark length will be found the best as a rule. The brightness of the fluorescent spot depends upon the degree of the evacuation, as the higher this is the brighter will be the light, but the less will be the sensitiveness of the deflection when excited by a given electric or magnetic field.

The diameter of the light spot can be diminished by magnetic coils surrounding the tube, through which an electric current flows. The intensity of the current (am-

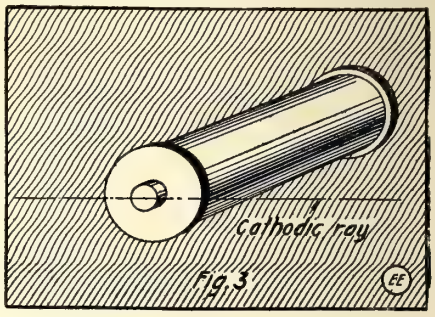


Fig. 3. Cathodic Rays Are Acted Upon by Magnets.

pere-turns) and the best situation of the coil is to be found out only by experiment. The smaller the spot is the brighter it becomes. While the sensitiveness is diminished by this operation, it is not to any disturbing degree.

A static machine of 20 or more discs may be used as a source of high-tension electric current for operating the Braun tube. Smaller machines, of course, can be used, but the intensity of the spot will not be so great. The best source of current would be a battery of some thousand accumulators, which may be of small size. L. Chaffee used the large battery of Professor Trowbridge, which developed in

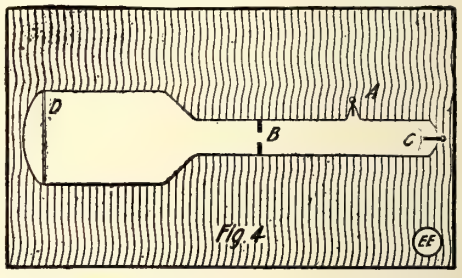


Fig. 4. Section of Braun-Tube.

most cases 20,000 volts. Induction coils should not be used, as the deflection depends upon the voltage of the current.

By using a Wehnelt cathode (i. e., an electrode covered with a spot of calcium oxide and heated by an electric current) a voltage of 1,600, 1,000 and even 600 volts is

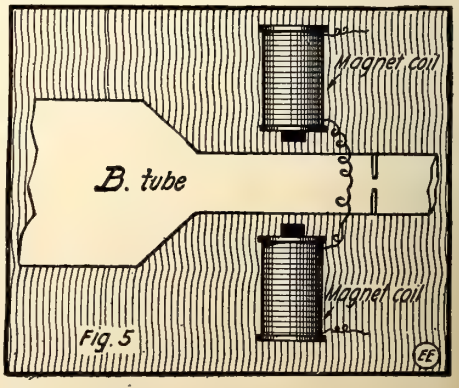


Fig. 5. Magnetic Control for Braun-Tube Ray.

sufficient for producing cathodic rays, although they are not very sensitive.

*This article was prepared exclusively for The Electrical Experimenter.

The great advantage of the Braun tube is that it will record a pulsating electric

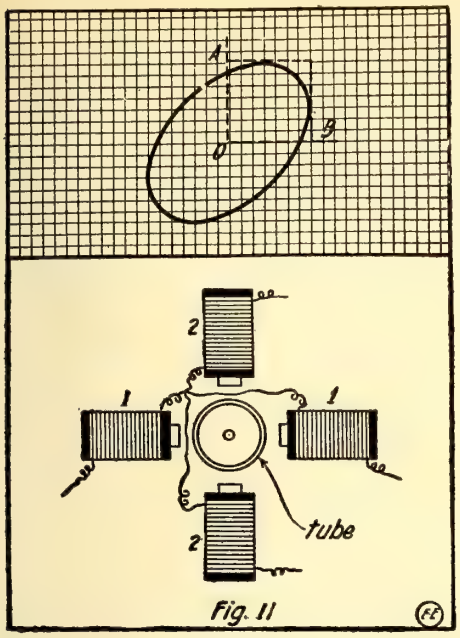


Fig. 11. Magnets Placed About Tube and Connected to Give a Phase Difference. The Curve Resultant is Seen Above.

current of frequencies which are impossible of registration in any other way. The difference between a galvanometer and a Braun tube may be explained by an illustration. It is a well-known law that the electro-motive force induced in a conductor which is moved in a magnetic field is proportional to the velocity. This cannot be demonstrated by a galvanometer, the deflection of which does not depend upon the instantaneous value of the current, but on the movement of a swinging element of definite inertia. The deflection of the cathodic ray depends only on the instantaneous value of the current or voltage. Consider a coil A connected with the indicator coil of the tube acting upon the rays. Give the coil A a small movement in a magnetic field. If the speed is slow the deflection will be small; as the speed is increased the deflection will be increased. *The absence of inertia* of the cathode ray enables one to gauge the static field by this tube then. This is extremely difficult to do with any other apparatus which we have at present.

I shall give several examples for the use of the Braun-tube:

1. *The Form of Vibration.*—There may be one, but better two "indicator coils;" one on the left, the other on the right side of the tube, as shown in Fig. 5. Let us suppose for the sake of simplicity that an alternating current is passed through the

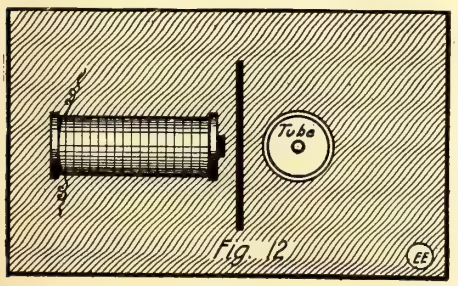


Fig. 12. Experiment to Demonstrate Screening Effect of Iron Plate Before Magnet.

coils. The light spot assumes the form of a straight line, the length of which measures the *double amplitude* of the current. If a revolving mirror is placed in such a manner as to catch the phosphorescent spot on the screen we can "see" the vibrations, literally speaking. If a moving film is passed near the mirror it will photograph the curve. The light of the spot in good tubes is strong enough to permit of taking photographs of it up to frequencies of about 1,200 *per second.*

Professor Zenneck has used the tube in many of his researches, and I herewith give several illustration of his work.**

Fig. 6 represents the vibration form from the current of a machine connected in a circuit with ohmic resistance only; the frequency (N) is 50. The fine points demonstrate higher harmonics (N being about 1,500). These latter are clearer in Fig. 7. There is a condenser of 10 Microfarads in this circuit.

Fig. 8 is taken with a current N = 1,080.

Figs. 9 and 10 are images of damped, coupled circuits (N = 250); Fig. 9 for loose coupling; Fig. 10 for close coupling.

The greater the frequency the greater the difficulty encountered in taking a momentary or instantaneous photograph. But if we can devise an arrangement which will cause the "light spot" to pursue exactly the same closed curve on the screen; for instance 100,000 times or more, we shall then be able to take a photograph of this standing figure. In this manner, the details of



Fig. 9. Loose-coupled, Damped Discharge.

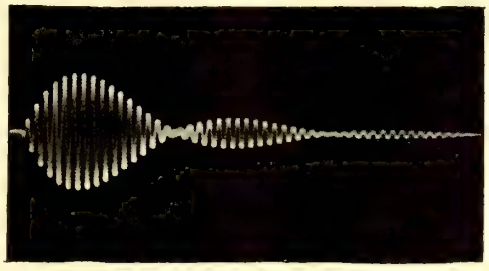


Fig. 10. Close-Coupled, Damped Discharge.



Fig. 8. Oscillogram of 1,000 Cycle Damped Current.

which cannot be explained here, as it will require too much space, photographs have been taken of oscillating currents at frequencies up to 1,000,000 or 1,500,000 cycles per second.

Let us suppose we have two sets of coils, 1, 1 and 2, 2 (Fig. 11), of which the axes are crossed at right angles. An alternating current of the same time period is sent through each pair of coils, but the current in the pair 1, 1 may have another phase than that in the second pair 2, 2. The "light spot" now describes an ellipse (the so-called Lissajou's "curve") on the screen. OA measures in a relative way the field resulting from the coil pair 1, 1, and OB that of the coils 2, 2. The phase difference is expressed by the situation of the axis of the ellipse. For the phase difference of 0°

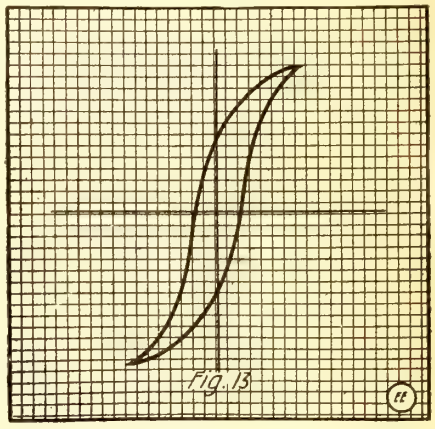


Fig. 13. Hysteresis Curve Obtained by Placing Iron in Coil.

and 180°, you observe a straight line; for 90° difference, an ellipse with axes vertical and horizontal. In any other case the ellipse would be in a different situation.

If the time period of the two interfering currents is not the same, but in the ratio 1 : 2, 2 : 3, etc., you observe other well-known curves.

We may now consider some lecture experiments. For simplicity we take only one coil (Fig. 12). We place a number of fine iron or nickel wires in the coil and the deflection of the spot increases. We bring a thin plate of the same materials in front of the coil and the deflection decreases; we now have a screening effect.

We next use crossed coils (Fig. 11). All the coils may be connected in series, but the two coils 1, 1 are connected in this manner so that their magnetic fields at their meeting place in the cathodic rays are opposed to each other. So we see on the screen a horizontal line measuring the (double) amplitude of the alternating magnetic field of the coils 2, 2. If we introduce into one or two of the coils a quantity of fine iron wire, then we observe a curve like that at Fig. 13. It is the hysteresis curve of the material; of course, not the true form of it, as the iron core is not a closed one and thus the curve is disturbed by the reaction of the free poles. However, it is clearly demonstrated by the curve that the magnetization of the iron, nickel, etc., depends upon the earlier magnetic states (the magnetic history of the piece).

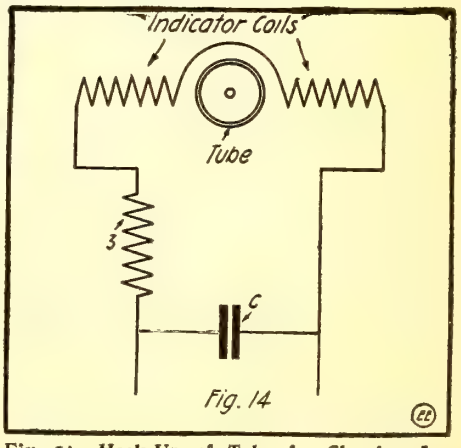


Fig. 14. Hook-Up of Tube for Showing Impedance Effect.

Suppose we use one or two indicator coils and a coil 3 (Fig. 14), having a great num-

***For a complete account of the apparatus used for taking photographs by means of the Braun-tube, see J. Zenneck Physikalische Zeitschrift, No. 14, of 1913, page 226.*

Baron Münchhausen's New Scientific Adventures

By Hugo Gernsback

The Planets at Close Range

WHAT is modesty? From childhood up I have been taught that this quality was more or less of a virtue, but developments of late cause me to believe that it is hypocrisy, plain and simple. I have found since, that modesty is something in us which we wish to make other people believe and which they realize perfectly is not so, or perhaps trying to make the other fellow believe something that you know isn't so. All of which might have a passing interest for you and then again it might not; probably the latter is quite true. Perhaps the above may have a certain bearing on this story and on the other hand it might not; probably that is quite true also.

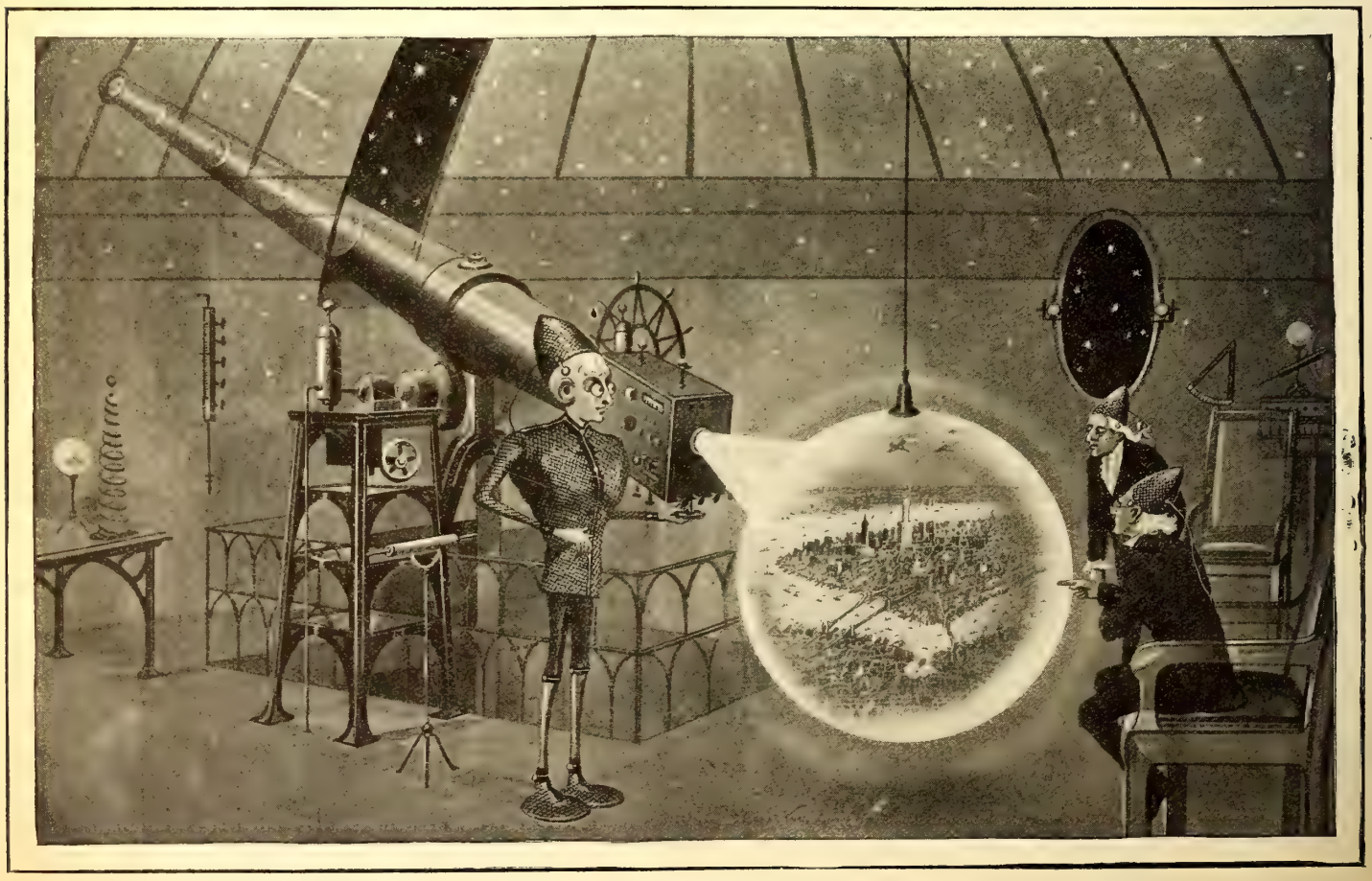
I have no fault to find with the Martians, and I believe implicitly what Münchhausen has been telling us about the utter frankness of the Martians and their habits. Only it doesn't work on earth, or at least it doesn't work in Yanktown. As will be remembered, Münchhausen told us a little while ago that the Martians live in transparent houses, for reasons best known to themselves. As will also be remembered, he told us that anything that is worth doing —on Mars—is worth doing with everyone looking on. He told us that non-transparent rooms make for nothing but laziness and vice; also that when your actions are open to the entire world you are more apt to lead an upright life than otherwise. We were told that for that reason no false make-believe life was lived on Mars as is the case on earth.

I tried the Martian recipe the other day, and I must confess here that it was a dismal failure. Now everyone knows, of course, that everyone else is apt to take a bath once in a while for strictly personal reasons, the only difference being that the frequency varies with some individuals according to taste and according to the available water as well as soap supply. I know that *you* take a bath and you know that *I* take a bath; certainly there is no secret about that. Nobody should find fault with such universal custom. But when I tried it the other day, leaving my bathroom window wide open, it somehow didn't work out according to the Martian recipe, at least Officer Mulligan, on the beat, who I believe had not read about the Martians' habits, didn't approve of my custom and very promptly arrested me when a big crowd collected in front of my bathroom, which happens to be on the ground floor. I have since given up trying to convert antiquated humans living on an uncivilized globe, to Martian standards of civilization. Perhaps in a hundred thousand years from now humanity will not feel so peevish about it, but until that date I shall believe in the proverb, "When in Rome bathe as the Romans bathe."

* * *

Promptly, as usual, that evening Münchhausen "called." On the minute at 11 p.m. the familiar whining, screeching sound reverberated in my 'phones, and immediately following the Baron's sepulchral rasping voice was heard once more.

"Good evening, my dear boy; mighty sorry I had to cut myself so short last night but, at that, I believe that the telegraphone wire on my radiotomatic was full to capacity before I stopped speaking. If my memory serves me right, I believe I had been telling you about the Martian elevated cities—and how the Martians do away with their choking dust filling up the atmosphere near the ground. I told you how the elevated Martian cities had perforated, metallic streets so that the fine dust would filter through the perforations thence to fall down to the ground. Possibly it occurred to you that in a few hundred years this dust settling on the ground below would rise high enough to fill up the 500 feet of intervening space between the ground and the elevated streets. If no means were taken to do away with such accumulating dust and sand this, of course, would be the result, but nothing of the sort happens, for Martian ingenuity naturally precludes any such occurrence. But how is the sand and dust done away with? It is a very simple mater indeed. Mars, as we know, is a very ancient world, which has cooled for centuries back. There are no more live volcanoes on Mars, for the very simple reason that the inside of the planet has cooled long ago, the same as is the case on your Moon to-day. Take the earth, which is a much younger heavenly body than Mars. On earth, as yet, the interior is in a molten state, proven by the fact that volcanoes still exist, as well as hot springs. Hot gases must naturally abound for if this were not the case there would be no pressure to force the molten lava through the craters of the terrestrial volcanoes. But a molten mass as well as hot gases take up room. Suppose the interior of the world



. . . Again the knobs were manipulated, and we now saw a most marvelous view of the City of New York, as if viewed by an aviator a few thousand feet above the earth. . . .

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WHEN the famous Italian astronomer Schiaparelli in 1877 first glimpsed the Martian "canals" through his modest telescope, the world at large believed his observations to be a mere optical illusion. Time and progress, however, have so improved our telescopes, such as, for instance, the one at the Flagstaff Observatory, that on account of the immense magnifying power, the "canals" stand forth sharp and unmistakable. How far can science go in increasing telescopic magnification? Will we ever see the Martians themselves through the telescope? Read this instalment and see.

would cool to-day; immense hollows or voids would naturally be created inside of the earth. This is precisely the case of Mars, which has now immense hollows and voids, and these are used for many different purposes by the Martians in their conquest of their dying world, as I shall show later.

"For one thing, every few miles beneath all Martian cities immense funnel-shaped holes are drilled till one of the voids is reached. The openings of these holes are constantly kept clear by the Martian engineers. How simple, then, is the thought of pushing the surplus desert dust and sand into these holes to do away with the sand nuisance. Very ingenious means are used in thus getting rid of the dust, and after every sandstorm, which are more or less frequent, the surplus sand and dust rolling on from the open deserts is forced into these openings as fast as it develops. Of course, it is impossible to thus get rid of all of the sand, but it helps in a certain degree to make life bearable on the planet.

"You will remember in my report of last night that on that evening Flitternix and I were on the Planet Ruler's mansion on top of the building looking down on the vast Martian capital that lay below us. We were watching in amazement the gravitationless fliers, which are used by the Martians almost exclusively for their transportation. I have told you previously that these fliers are flat, pancake-like, metallic bodies with three masts spaced equally distant from the center. We saw thousands of these gliding noiselessly through the thin Martian air, their intense yellow propelling light shafts plying all over the sky and over the ground. It is indeed an inspiring sight to see thousands of these flyers in the air all the time, and the spectacle becomes even more amazing when night comes. The yellow emanation rays are highly luminous, and for that reason no other searchlight is required. As long as I have been on Mars I have never witnessed a collision, although these astonishing vehicles fly so close to each other that one sometimes thinks they must collide. Each Martian building on one of its sides has a metallic landing platform extending at right angles from the building. There the fliers land to deposit passengers or freight.

"We were watching this amazing spectacle; it was in the early evening and the sun had just set. Being accustomed to twilight we naturally thought it would stay light for some time to come, but we were surprised that no sooner had the sun disappeared behind the western horizon than the landscape became pitch black. I was about to comment upon this unusual phenomenon when Flitternix forestalled my questions, launching into his usual astronomical reflections.

"'My dear Baron,' said he, 'no doubt you have been surprised that there is no twilight on Mars, but the reason, of course, is very simple. The earth to which you are accustomed has a very dense atmosphere. After the sun has sunk below the horizon its rays still strike the atmosphere above you, although you cannot see the sun itself. Naturally, it does not become dark immediately for the reason that the light is diffused in the air above you up to about 30 miles above the surface of the earth. In other words, the sun on earth acts exactly like a searchlight which is hidden from your sight while its light shaft plies above your head. You can see the light perfectly over head, and the sun's rays act in a similar manner on earth.

"'On Mars, however, the atmosphere is very thin and only reaches a comparatively few miles above the surface of the planet. Therefore but little light is diffused in an attenuated atmosphere, as is well known to you, and for this reason no twilight can exist on Mars; this you have just witnessed. As previously experienced during our stay on the moon, where there is no air of any consequence, everything must be dead black or white, there cannot be any grays in the transition from light to dark. On Mars, of course, such extremes do not exist for the reason that there is still some atmosphere to diffuse the light.'

"While Flitternix was still talking we saw the marvelous sight of the city below us being illuminated at the precise moment when the sun had sunk out of sight.

"Nearly every structure and building on Mars is of the same height. On top of their cone-shaped roofs several immense, transparent spheres are spaced 20 to 25 feet apart. These balls are usually arranged in a circle or in an equilateral triangle. No sooner has it become dark on Mars than these transparent balls emit a dazzling rose-white light. This light does not emanate from these globes in form of a shaft, as we are accustomed to from searchlight illumination. Quite the contrary; the light spreads out in all directions for a distance of over 500 feet. The strange fact is that the light is as strong at this distance as it is in the immediate vicinity of the spheres. As a matter of fact, it is strongest about 25 feet from the balls themselves. Inasmuch as every building and every elevated structure gives forth this spreading light every object within 500 feet of the light balls is illuminated almost as strongly as in daytime with the sun shining. This creates the curious result that when walking in a Martian street at nighttime daylight is simulated in a perfect manner and it is hard to realize that it is not, indeed, sunlight that is pouring down upon you. Not only do these transparent light balls give out light rays, but the rays also emanate heat prodigiously. This is quite necessary. I have spoken before of the fact that the Martian atmosphere is very thin and attenuated. Naturally such a thin blanket of air cannot retain the solar heat during the night, and for that reason the nights on Mars are extremely cold. This is true of the temperate as well as of the other zones. For this reason the light rays of which I spoke before have been made to radiate heat as well, otherwise it would be too cold to walk on the streets after nightfall. As it is, the temperature is but slightly below that which exists at noon time. It will, of course, be plain to you that as soon as the sun rises in the morning the light balls are switched off, for then there is no further use for them.

"You might think that it would be an enormous undertaking to light and heat vast cities by such artificial means, but the cunning Martian wherever possible lets Nature do all of his hard work. I have already shown to you how the Martians moved the water in their canals and waterways by means of the all-dominant sun, and if our luminary can perform useful work during the daytime why not use it at night? I have mentioned before how the Martians harnessed the sun's energy, storing up enough power to use the surplus after sunset. Thus we find the curious phenomenon on Mars that the intelligent beings inhabiting this planet have harnessed enough energy from the sun during the daytime that when released it furnishes them with light and heat during the night. The sun's energy during the daytime is converted into electricity, as I have already shown, and is then stored for further use. Consequently the night illumination and heat is derived primarily from the sun and costs the Martians nothing. When you consider how crudely you humans use your energy it must dawn upon you that you are still very young children. At that the inhabitants of the earth are doing precisely what the Martians are doing except doing it in a very bad way. You are already deriving 100 per cent. of your light, heat and power from the sun *indirectly*. The coal which you are mining this minute derives its original energy from the sun. Millions of years ago great forests—which were directly a product of the sun—sunk into the earth, thereby carbonizing the wood. This wood you are burning as coal to-day. In other words, you are using sun-power, stored millions of years ago. Even your water-falls from which you derive your power are directly dependent upon the sun. Without the sun to suck up the water from the seas into cloud form, your water-falls would run dry within one week. The Martians, who have long ago exhausted such means of utilizing the sun-power, are now using the sun-power supplied by the sun yesterday. You on earth to-day are using sun-power stored millions of years ago. After your coal supply gives out and after your water supply is not as abundant as it is at present you will revert to exactly the same means as do the Martians on their dying planet to-day.

"After dinner the Planet Ruler took us to a vast circular room high up in the mansion, which we presumed to be his study. The thing that struck us most forcibly at once was an enormous glass-like transparent rod which broke through one of the transparent walls of the room. This rod probably measured two or three feet in diameter, and as far as we could see it it was about 15 feet in length. We afterwards found out that it extended 75 feet beyond the building, pointing toward the sky. The thought immediately forced itself upon us that it was a form of telescope, which indeed it was. It was arranged in telescope fashion and by means of machinery located outside of the room, the far end could be made to point to any object in space. As the mansion of the Planet Ruler revolves around its axis, as I have already mentioned to you previously, the telescope may thus be pointed at

(*Continued on page* 741.)

Marvels of Modern Physics

By Rogers D. Rusk

Assistant Instructor in Physics, Ohio Wesleyan University

Invisible Radiations.

IN very recent years many forms of radiation have been discovered which do not affect the eye, and hence are invisible. Already the benefits which have resulted to mankind have been of infinite value, even though this branch of physics is only in the infancy of its development.

Radiations may be roughly divided into

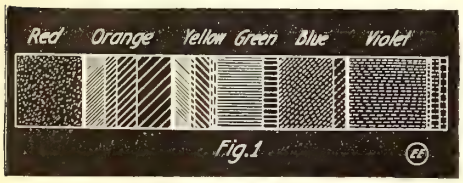


Fig. 1. How the Colors of the Visible Spectrum Range Themselves.

two general classes; (1) those which consist of material particles traveling at high rates of speed, and (2) those which consist, not of material particles but of vibrations in the *ether* similar in nature to ordinary light waves. The first of these classes we will leave until we have considered the various kinds of *ether waves*.

Consider a beam of sunlight passed through a prism. The different lengths of light are spread out in a broad band of colors. The same thing happens when sunlight is reflected and refracted by raindrops, and we see the rainbow. When the light waves strike the prism at an angle they are slowed down in speed and also bent a little from their original path. The violet waves being the shortest, are bent the most; and the red waves, being longest, are bent least of all. The colors now range themselves, as shown in Fig. 1, in the order of their wave lengths.

The perfect blending of the colors thus demonstrates clearly that the waves vary gradually in length, from the longest to the shortest, but it must not be thought that they suddenly cease to exist at the upper edge of the violet or the lower edge of the

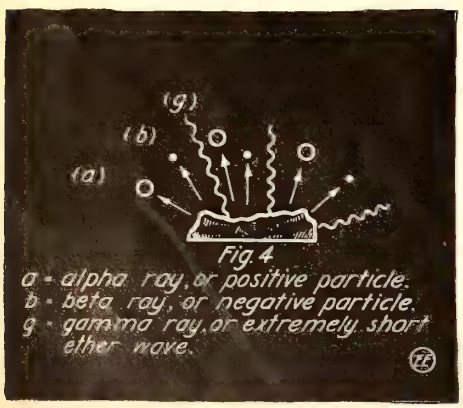


Fig. 4. How Invisible Radiations Occur About Radio-Active Substances, Such as Uranium.

red. It is quite true our powers of visual perception cease very suddenly at those points, but it is easily proved that waves of other lengths exist beyond them. Those of us who are imaginative often wonder what strange colors might be beyond the violet and the red, if only they were visible.

Red light has been measured as having a wave length of 1/37,000 of an inch, and violet a wave length of 1/70,000 of an inch, while the orange, yellow, green and blue are intermediate. As we know that light travels at the velocity of 186,000 miles per second, we can easily calculate the number of vibrations made in a second by each kind of wave. (See Fig. 5.) A single wave, then, travels in a second about 10,000,000,000 inches, and 10,000,000,000 times 37,000 equals 370,000,000,000,000, or a red light wave vibrates approximately 400 million-million times per second. In the case of violet light the vibration rate is about 700 million-million times per second. The wave lengths cited below will give a clearer idea of this factor.

COMPARISON OF WAVE-LENGTHS.

Wave.	Length in cm.
Hertzian wave.*	1,500,000.
Hertzian wave.†	0.5
Heat waves (longest)	0.13
Red light	0.000077
Violet light	0.000036
Ultra violet.‡	0.000010
X-rays	0.00000001
Gamma rays	0.000000001

* Longest yet generated.
† Shortest yet generated.
‡ Shortest in solar spectrum.

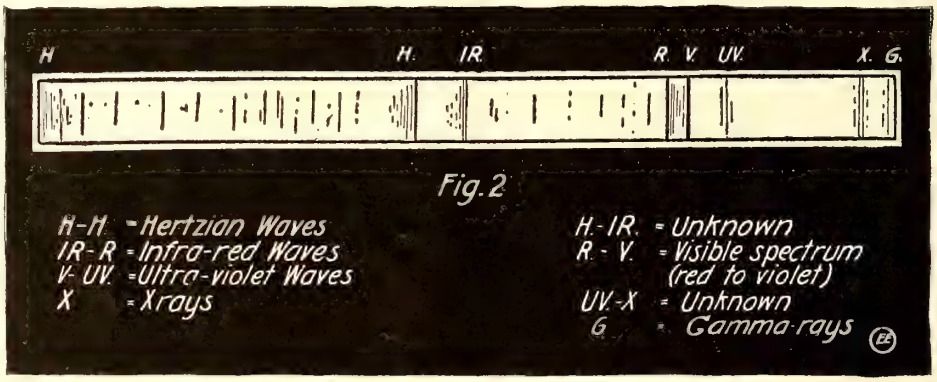


Fig. 2. Extended or Invisible Spectrum Shown Diagrammatically.

The visible spectrum can be divided into three general divisions—the red and orange, or heat portion; the yellow and green, or luminous portion; and the blue and violet, or chemical portion, sometimes called the actinic.

Langley traced the longer rays beyond the visible eye (known as the infra-red) for 10 octaves below the visible spectrum, largely by means of an instrument called the *bolometer*. An octave in light, it may be stated, is similar to an octave in music; that is, it is the interval between two lengths of waves, one of which is twice the other. The visible spectrum, then, is approximately one octave. Langley's bolometer was merely a sensitive Wheatstone bridge with one arm made of blackened platinum. Infra-red rays falling on the blackened arm would be absorbed, and the resulting change of resistance due to a rise in temperature would be apparent from the deflection of the galvanometer. Thus the change in temperature could be measured.

The ultra-violet rays, on account of their chemical or actinic properties, have been easily traced by using the common photographic plate for about two octaves above the violet. Waves shorter than this are absorbed by the air.

It must not be thought that the three classes of waves in the visible spectrum were so named because they possessed one property alone. Any of the waves possesses all three properties to a greater or less degree. The classification only serves to emphasize the more prominent characteristic of each. The close relation of the various waves can be seen by taking a cannon ball and heating it. At first very

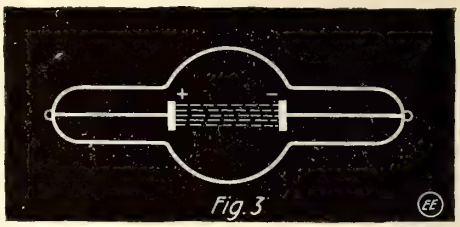


Fig. 3. Simple Tube for Studying Electric Discharges in Vacua.

long waves are given off, and as the iron becomes hotter the waves become shorter. Finally red light is emitted, and then the cannon ball passes through the stages from red to white heat. That heat waves are only long, invisible light waves is readily seen.

The great scientist Hertz, in addition, proved that electric waves produced by the spark discharge of an induction coil are identical in nature with light waves, and are reflected, refracted and polarized according to the same laws as light waves. Hertz in his experiments used waves of eight or nine meters length. Since then, in wireless telegraphy and laboratory research, waves have been produced directly, varying in length from several thousand meters to only few millimeters. The shortest, however, are many times longer than the longest visible wave.

Radio detectors are able to detect these long waves due to their heating and other manifestations.

These relations which we have noted lead us to the thought that a complete or extended spectrum can be diagrammed in the same manner as the visible spectrum, and

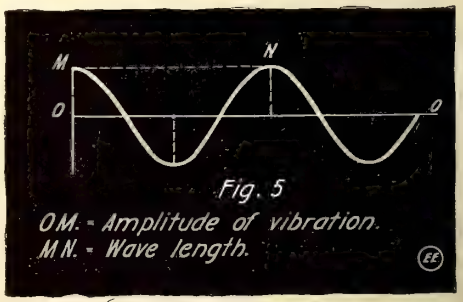


Fig. 5. Components of a Transverse Vibration or Wave.

in Fig. 2 we have the different waves arranged in the order of their length, from those of thousands of feet to those of only a few trillionths of an inch wave length. Such a comparison is valuable. More striking phenomena have been noted in the

(*Continued on page* 736.)

The RADIO LEAGUE of AMERICA

HONORARY MEMBERS
CAPT. W.H.G. BULLARD, U.S.N. NIKOLA TESLA.
PROF. REGINALD FESSENDEN. DR. LEE DE FOREST.

Manager, H. Gernsback

How to Organize and Conduct a Radio Club

(Concluded)

To Effect an Organization.

CONSIDERING that a regular club is to be organized with fifteen to twenty or more charter members, the following parliamentary rules are useful:

After a call to order has been given for a stated meeting or to effect a certain organization, any person interested, or appointed by common consent, may call the meeting to order and state the reason for the assemblage, asking any of those assembled to nominate a chairman. He puts motions or nominations to vote until the majority agree upon one man who is declared elected, takes the chair and proceeds to conduct an election of secretary and the other necessary officers required for the time being, until a permanent organization can be effected; these officers can be made permanent if the assemblage so agrees. The organization also can be made permanent by a vote. The chairman appoints a committee to draft a constitution, by-laws and rules of order, which should contain at least these articles:

1. The name and object of the society. 2. Qualifications of membership. 3. Officers, how elected (i. e., by oral or written vote) and duties. 4. Meetings of the society. 5. How to amend the constitution. At a second meeting the constitution should be adopted and signed by all who wish to become members; by-laws can be adopted and a committee appointed to nominate permanent officers to be elected at this or a future meeting.

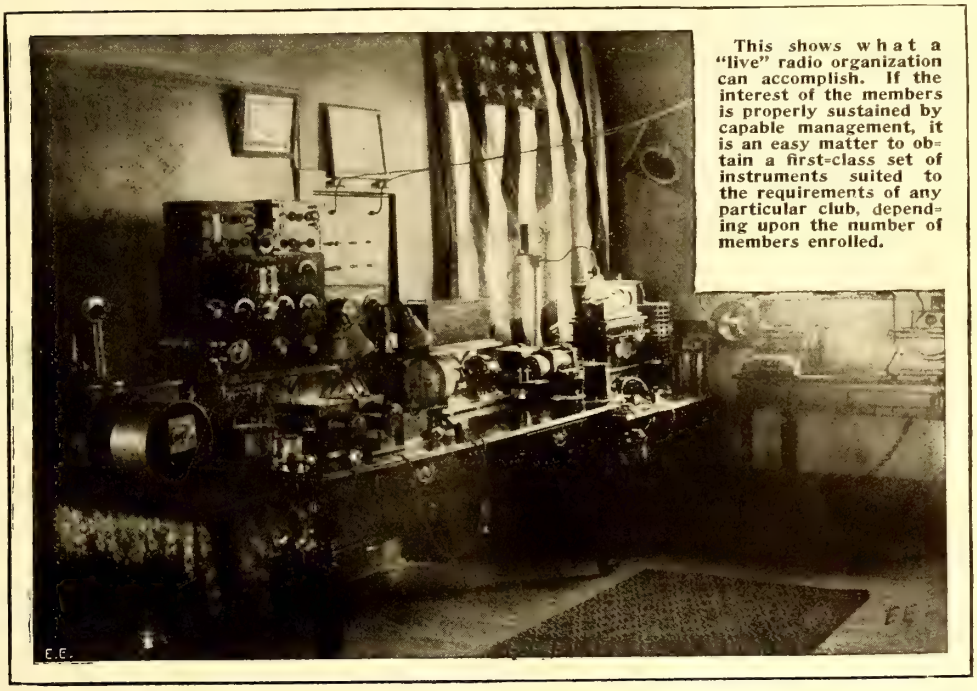
Duties of the Several Officers.

The chairman or president enforces the rules adopted; calls the house to order; announces its business; sustains order; explains and decides questions of order, with the provision of reversal being given the house; appoints all committees not otherwise provided for; recognizes speakers; sumbits motions; puts to vote all questions regularly moved; announces results; signs official documents. He is given precedence in speaking on questions of order and decides tie votes.

The vice-president acts for the president in his absence. In his absence the secretary acts.

The secretary records the proceedings of the organization; writes all letters; calls the roll for absentees or votes; reads minutes of previous meeting; reads all papers and documents to the organization; keeps committees informed of their work; signs all records and is responsible for all papers belonging to the organization. The secretary can act in the absence of both president and vice-president to appoint a temporary chairman.

The corresponding secretary has charge of all correspondence received or sent out by the organization.



This shows what a "live" radio organization can accomplish. If the interest of the members is properly sustained by capable management, it is an easy matter to obtain a first-class set of instruments suited to the requirements of any particular club, depending upon the number of members enrolled.

Extraordinarily fine and complete wireless station owned by the Colorado Wireless Association, of Denver, Colo. Workshop and club room (here shown) obtained through courtesy of local Y. M. C. A. Transmitting equipment includes two 1-Kw. rotary quenched spark sets giving a night sending range of 1,000 miles (maximum 1,500 miles). Receiving apparatus incorporates ultra-audion and two-step amplifiers with tuning inductances for waves up to 20,000 meters. They hear practically everything in the ether between Germany and Honolulu, Alaska and Panama. The station's call is K I X (limited commercial government license). Secretary's address, Lawrence P. Hough, 1060 Josephine St., Denver, Colo.

The treasurer handles all moneys of the organization, receiving and disbursing as ordered by vote, and accounts for it to the society.

Length of Time Which Office is Held.

Officers should be elected to serve for six months, or at the longest for one year.

Membership.

Membership implies that a person has been regularly received according to the rules of the organization and has duly signed the constitution. A member must obtain the consent of the chairman before he can address the house; must speak only on the subject in hand, unless otherwise permitted; must give due respect to fellow members in his speech and promptly yield to the chairman's call to order. A majority of members constitutes a quorum, unless otherwise designated by the constitution.

Motions.

A motion can be made by any member who properly obtains the audience of the house, but after a motion has been seconded it cannot be recalled except by the permission of the house. No motion can be made while a member is speaking nor while another motion is before the house. Motions must be written if so desired by any member or vote of the house.

General Order of Motions.

1. To appoint a time for adjournment, B. 2. To adjourn for unlimited recess, A E F. 3. Orders of the day, A E H N. 4. To lay upon the table, A E G. 5. Call for the previous question, A E M. 6. To postpone action to a fixed time, C. 7. To refer to committee, D. 8. To amend or to reconsider, I K. 9. To suppress or postpone indefinitely, D E.

Rules Governing Motions.

A. Not debatable. B. Not debatable while another question is before the house. C. Limited debate allowable on propriety of postponement. D. Concerns the main question. E. Only amendment permitted is a motion to adjourn. F. Cannot be reconsidered. G. If voted for affirmatively, cannot be reconsidered. H. In order even when another has the floor. I. Precedes all except adjournment, but cannot be put by any person voting with the minority. K. A motion to amend an amendment cannot be sustained. L. The chair is sustained when an appeal to the house results in a tie. M. Requires a two-thirds vote, unless special ruling is made. N. No second required.

A Question.

A question should be put first on the affirmative side, and then on the negative. If any doubt arises as to results, a division of the house may be had. A question can be lost in a tie unless the chairman casts the deciding vote affirmatively. After a question has been put, it is not debatable until after the affirmative is put, when anyone, not having spoken before, may speak before the negative is put. Several questions in one may be divided and taken separately. No one can vote on a question af-

(*Continued on page* 728.)

RADIO DEPARTMENT

Radio Range and Direction Now Found by Instruments

INESTIMABLE in value has been the boon conferred upon man by the invention and development of wireless telegraphy, but its full value has never yet been attained, because of serious defects.

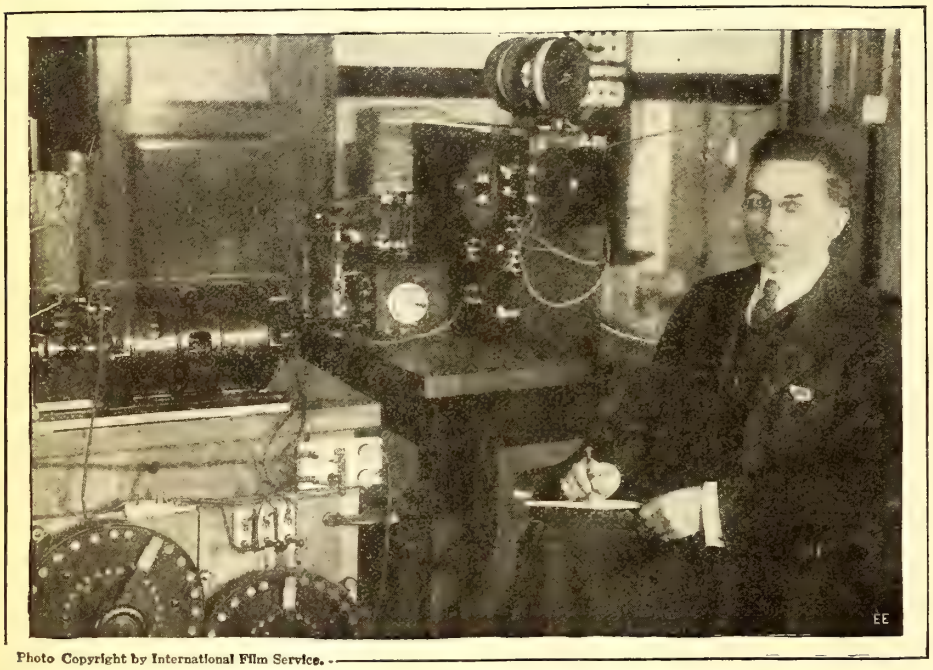


Photo Copyright by International Film Service.

Frederick Kolster, of the U. S. Bureau of Standards, Inventor of New Radio Range and Direction Finder and the Apparatus Used.

Only vaguely and entirely by guess could a trained wireless operator tell by the strength or weakness of the "spark" the distance between himself and the instrument transmitting the call to which he was listening.

It has been left for one of the United State radio experts—Frederick Kolster, of the Bureau of Standards—to develop a satisfactory radio device of simple design, capable of ascertaining not only the *range*, but also the *direction* from which the wireless message emanated.

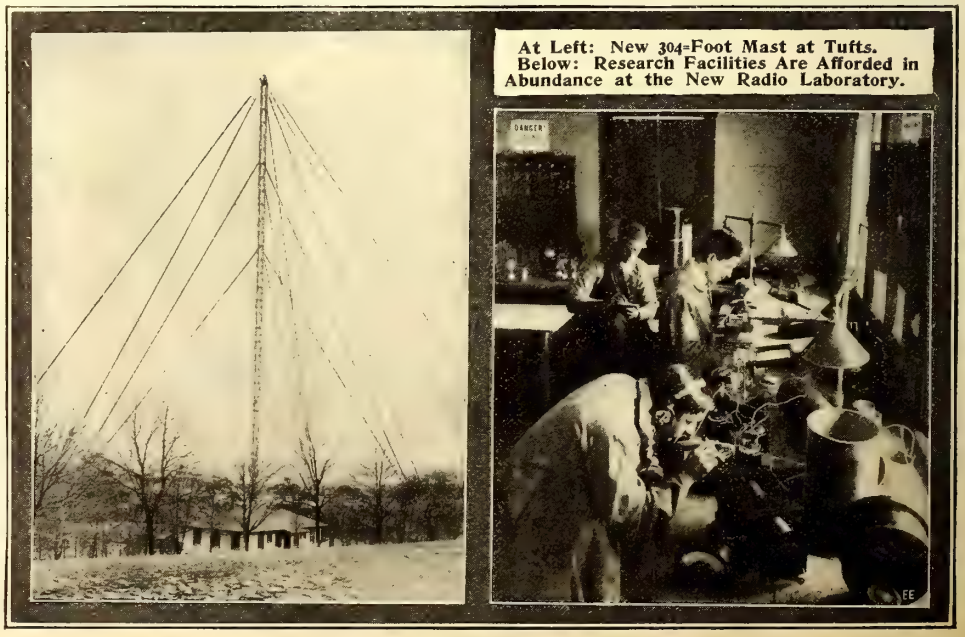
It is said that the device has proven very satisfactory in a number of careful tests conducted by the Bureau of Standards. Messages have been received on one or another of three different sizes of instruments that have been built so far—from Philadelphia, Boston, Glace Bay, Newcastle (N. B.), New York, Norfolk, New Orleans, Panama, Key West, San Diego and Hanover, Germany. This new device, perfected by Mr. Kolster, also cuts down the atmospheric disturbance effect noticeable in practically all other radio telegraphic receptors. The direction-finding apparatus of this inventor's design is operated entirely indoors, having no antenna and no earth or outside connection. Such a device is much in demand by radio inspectors and agents of the commercial radio companies for the purpose of checking up ship locations, interfering stations and the distances between ships, also between ships and lighthouses or fog signaling stations. Also it should find considerable application in the military service for field and trench work as receiving apparatus thoroughly portable, requiring no antenna or ground as aforementioned, is of light weight and can be readily carried by one man. Another distinctly useful application for it would be in the Coast Guard service in receiving distress signals, as they would be able to locate their source at once.

The photograph herewith shows Frederick Kolster, of the Bureau of Standards, and his new radio direction and range-finding apparatus.

TUFTS COLLEGE HAS NEW HIGH POWER RADIO STATION.

THERE has recently been completed and set in operation at Tufts College, Medford, Mass., a high-power radio station, one of the best equipped in the United States. The great feature of the station is the immense skeleton steel, aerial mast, 304 feet high, which is embedded in solid concrete. The new tower may be seen for miles, its slender black framework, only 3 feet 6 inches square at the base, silhouetted against the sky. The tower is supported on four specially designed porcelain insulators which are firmly secured in 15 tons of reinforced concrete. The mast is constructed of 12-foot sections of structural steel and is held in position by 12 heavy crucible steel guy wires, one inch in diameter, secured at different heights and embedded at their bases in blocks of concrete. The tower is topped by a huge antenna which extends outward like a monster open umbrella. This shaft is said to be the highest in New England and the third highest in the United States.

A few feet from the tower stands the laboratory building, also built of concrete. To the casual observer this solid looking structure has little significance. The expert, however, will find carefully housed there, a complete outfit of high-power wireless apparatus, machinery and tools of the



At Left: New 304-Foot Mast at Tufts. Below: Research Facilities Are Afforded in Abundance at the New Radio Laboratory.

(*Continued on page* 727.)

SENSITIVE MICRO-AMPERE WIRELESS RELAY.

It has been the dream of radio engineers for years that some day a relay would be perfected that would be sufficiently sensitive to respond to the extremely weak currents in circuits of wireless receiving sets, and we believe that the relay here described fills most of the requirements.

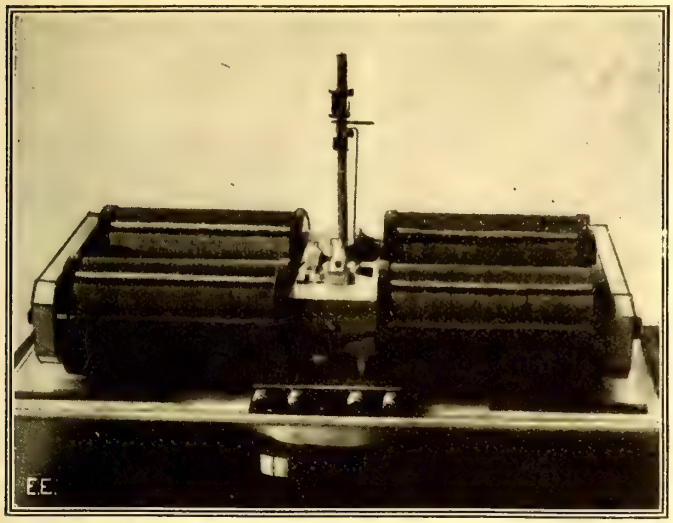


Fig. 1. A Wireless Relay That Operates on One-Millionth of an Ampere.

The apparatus as designed by Fritz Lowenstein, of New York, a well-known radio engineer, will operate on any receiving detector and is recognized as the most sensitive detecting device for electric current ever constructed for commercial use, as it will be deflected by a current of 1 micro-ampere (1 millionth of an ampere).

This super-sensitive relay is illustrated in Fig. 1, mounted complete on a stand, while Fig. 2 shows the details. The moving element C is wound with a coil of extremely fine wire and carries a contact D which makes connection with a small pool of mercury E when the armature is deflected. The moving part is supported on two-jewel bearings to eliminate friction and the connections to the moving coil consist of two very fine helical copper springs suspended at both ends. The upper spring is very clearly shown in Fig. 1. Two small discs F, F, are provided to regulate the swing of the coil, which is mounted between two pole pieces BB that are energized by the massive coils shown at A, A, A, A. The coils are so connected that the two pole pieces will have different polarities, thus forming a N. and S. pole. The current for these magnets is obtained from a 110 volt direct current supply and is led in through the wires G.

The operation of this wonderfully sensitive relay is as follows: The powerful electro-magnets are first excited and the moving coil is connected to the receiving outfit in place of the regular 'phones through terminals H, and a calling device, such as a bell, at the terminals I. When the coil C is excited by the feeble current produced by the detector, which, of course, is received by the other instruments from the radio transmitting station, it will turn, and its lever D will make contact with the pool of mercury E, thereby completing the circuit which causes the calling device to operate. The bell can be replaced with a tape register by which messages can be readily copied. This, of course, must be operated at a slow speed, as the moving coil has an oscillation period of .1 of a second. The oscillating frequency period can be changed by varying the distance of the levers F, F, and the coil. The ivory bone cup in which the mercury is kept can be moved either forward or backward by operating a small thumb screw located at the end of the container.

The complete relay is supported on a table that can be rotated to offset any detrimental effects of the earth's magnetic field. A suitable cover with a glass top is placed over the instrument to prevent any dust settling on the delicate moving parts. This device is capable of withstanding shocks and will work even when slightly tilted, for it has been tested on moving vessels and the results were very satisfactory.

Although the relay is adopted for radio work, it will be very useful in a laboratory where it is necessary to detect very minute or feeble currents. By mounting a sensitive microphone to make connection with the winding on the moving element this apparatus might then be used as a telephone relay, second only to the audion in sensitivity.

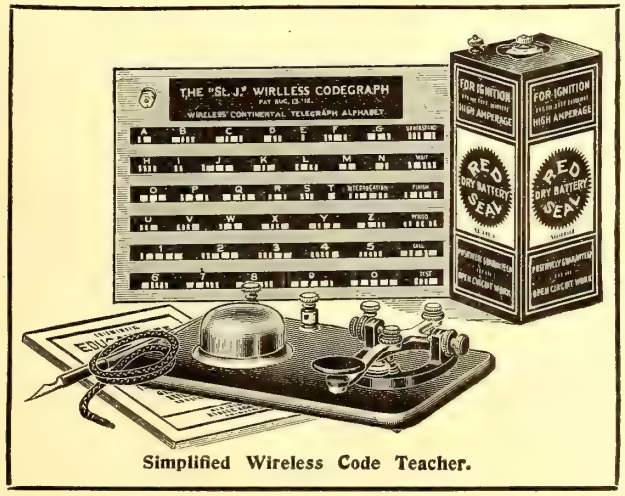
NEW WIRELESS CODE INSTRUCTOR.

A very simple wireless and telegraphic code instructor is that known as the "Mesco Codegraph." This outfit employs an enameled metallic plate, as perceived from the illustration, and on the face of which are arranged the dot and dash signals corresponding to the letters of the alphabet. The signal characters have the enamel left off them.

This little plate is connected up with a dry cell and ordinary buzzer, together with telegraph key. Ordinarily the Morse key shown is not used and the circuit is completed through the buzzer (or a sounder) by means of a steel pen, which is drawn across the bare metal dot and dash signals on the face of the metal plate.

These dots and dashes have the enamel scraped off, as explained, and thus a circuit is completed so as to give the proper sequence of signal characters. It is possible, of course, to thus learn the code without a teacher, and the speed may be varied as required, according to how fast the pen is drawn across the plate.

This neat little outfit should find a wide field of usefulness among the younger radio students who do not care to invest in a high priced instrument for the purpose.



Simplified Wireless Code Teacher.

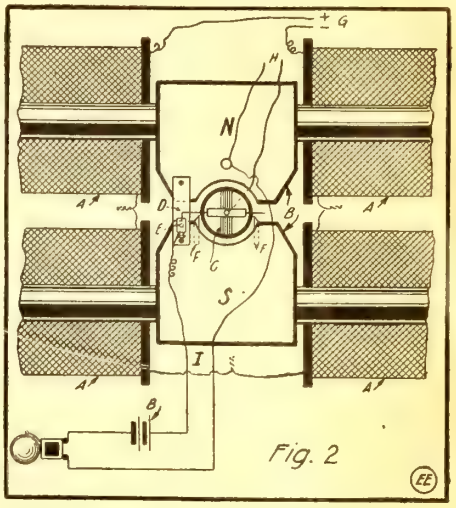


Fig. 2. Details of "Micro-ampere" Relay Moving Element

PUPIN'S NEW NON-INTERFERENCE ANTENNA.

After giving an interesting discussion on the formation of electro-magnetic waves in the ether, with special regard to their adaptation in wireless telegraphy, Prof. M. I. Pupin, the well-known electrical engineer, discusses briefly the theory on which his new non-interference radio device operates, in *Science*.

In the elucidation of his theory Prof. Pupin goes on to say: "The eye sees a very narrow strip of wave frequencies which are sent from a radiating body; the ear hears but a very narrow strip of wave frequencies which vibrating bodies can send out. Physiological optics and physiological acoustics deal with these remarkable facts. Now, the reason why the eye is blind and the ear is deaf to an enormous range of frequencies is certainly not due to anything like ordinary selectivity produced by tuning.

"Fifteen years ago I published several investigations which deal with electrical motion in sectional wave conductors. One of these resulted in the now well-known loaded telephone line. I regret that the technical importance of this invention, by attracting too much attention, has overshadowed completely the full meaning of the general mathematical theory which underlies it. This theory says that sectional wave conductors (presumably in the form of inductance coils) can be made which will absorb almost completely all waves above or below a certain small range of frequencies, and the selectivity thus obtained has nothing to do with ordinary electrical tuning. In other words, the selectivity of the eye and of the ear can be imitated by coarse structures like sectional wave conductors. Electrical pulses produced by the static are for the most part very short and their action is equivalent to the action of highly damped electrical oscillations of very high pitch. This action can be entirely absorbed so that no part of it reaches the receiving apparatus of a wireless receiving station if between the antenna and the receiving apparatus a sectional wave conductor is employed which will not transmit electrical waves of a fre-

(*Continued on page* 733.)

Electrical Losses in Radio Transmitting and Receiving Sets

By James L. Green.

PART I.

THE TRANSMITTING SET.

THIS article endeavors to deal with radio power losses and their prevention. The design and construction of commercial radio apparatus is now rec-

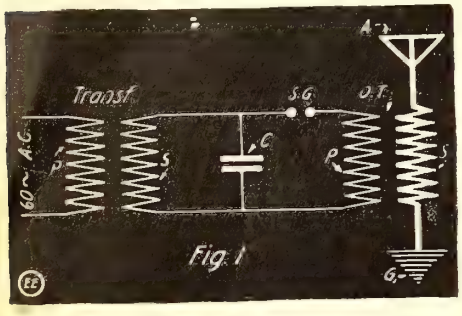


Fig. 1. Typical Radio Transmitting Circuit.

ognized as an important branch of engineering, and great care must be exercised so that the set will operate with the greatest all-around efficiency.

This requires that the electrical power losses be kept at a minimum and a maximum amount of energy radiated or received for a given input of power.

The equipment of a wireless station may be divided into two parts: 1. Sending set. 2. Receiving set.

Let us first consider the sending set: Take the average one-half kilowatt amateur set shown diagrammatically in Fig. 1, and consider the apparatus from left to right.

A. Sending Key.—The average amateur wireless key usually consists of an ordinary telegraph key with heavy contacts. Since the losses in a key are usually those due to heating of contacts and formation of oxides, dirt, etc., upon their faces, these may, by the use of *large studs,* be reduced until they are negligible. Other losses, i. e., at bearings may occur if these are allowed to work loose or become dirty or covered with oxides.

B. The Transformer.—For a full treatise on transformer losses the reader had best consult an engineering text-book on alternating current machinery. However, the more serious transformer losses are:

1. Conductor Loss.—Whenever a current traverses a conductor heat is developed. The amount of loss due to this heat is given by $W = C^2 \times R$, where W = loss in watts, C = current in amperes, and R = resistance of conductor in ohms. The copper loss is due to heating of the windings; and, to make this as small as possible, large wire must be used. There is, however, a limit to the size of wire used, as too large a wire makes the transformer bulky and thereby increases iron losses. For this reason transformers are nearly always designed with a certain copper loss—about 5 to 8 per cent.

Suppose now we wished to know the primary resistance for a transformer whose input = 440 watts and whose copper loss is 5 per cent. Then we can calculate the resistance for the primary of a transformer which on 110 takes four amperes.

From	$W = C^2R$
We get	$22 = 4^2R$
Whence	$R = 1.375$

Therefore, the primary resistance may be as high as 1.375 ohms for an allowable copper loss of 5 per cent.

In general the primary resistance of the amateur's transformer is less than this, so it is probable that the conductor losses of the ordinary amateur transformer are quite low.

2. Core Loss.—The iron losses in transformer cores may be divided into two classes: viz., hysteresis and eddy currents.

a. Hysteresis Loss.—When iron is subjected to the action of a magnetic field produced by an alternating current its polarity will change with every reversal of the current. To this change of polarity the iron offers a resistance. The lag in responding to such a change produces heat and is known as *hysteresis.* This hysteresis loss is small in soft iron and increases with the hardness of the iron. It may be reduced by using very soft transformer iron and by keeping the volume of the iron small.

b. Eddy Currents.—Since a conductor placed in a varying magnetic field has a current induced in it the iron in a transformer core, being subjected to an alternating current magnetic field, has currents induced in it. These currents are known as Eddy or Foucault currents, and run crosswise through the core. Hence, to minimize them, we can make the core of thin laminations of iron, insulated from each other.

In commercial practise the laminations are treated with acetic acid for a few hours until a thin film of rust forms over them. This has one advantage over shellac, which is often used by the amateur, as no amount of heating can burn or melt it. In the ordinary amateur type transformer, if built of transformer iron, insulated as described, and used on 60-cycle A. C., the loss due to hysteresis may not be more than 5 to 8 per cent. of the input.

3. Condenser Losses.—The losses in a high tension condenser are of two kinds.

a. Hysteresis.—Since the two plates of a charged condenser contain opposite charges, i. e., one positive, the other negative, and as these plates are separated by a dielectric there is always a strain across the dielectric, due to the attraction of the two charges. This strain is known as an electrostatic strain. If the charging current be alternating, then the strain will be first in one direction, then in the other. The dielectric will display an effect similar to magnetic hysteresis; i. e., it objects to the change of direction of strain. This reluctance causes power loss and is known as *dielectric hysteresis* and its energy is expended in heat. The amount of hysteresis loss in a condenser varies with the material used in the dielectric. It is dependent on: 1. Chemical composition of the dielectric. 2. Temperature. It is very small in air condensers and those having transformer oil, or flint glass as dielectric and quite large for ebonite or micanite.

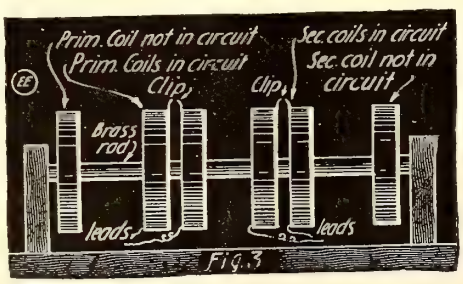


Fig. 3. Suggested Form of Loose Coupler Employing "Unit" Inductances Instead of Sliders or Switches.

b. Brush Discharge.—The *coronas,* or discharges of light, that issue from a highly charged conductor are known as *brush discharges.* They are most frequently noticed at sharp points or edges, and a portion of the charge is often thus lost in the air. This discharge is often noticed in antennæ and inductances, and is a particularly serious form of loss; for, besides part of the charge being lost in the surrounding conducting layer of air, the capacity of the circuit will be changed and thus the set will be put out of resonance. To overcome brush discharge

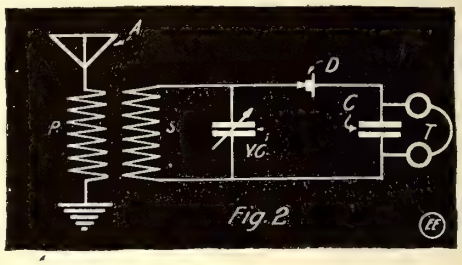


Fig. 2. Regular Wireless Receiving Circuit for Loose Coupled Tuner.

the condenser should have few, if any, sharp edges and should be of the oil-immersed type.

4. Spark Gap.—The losses in the spark gap are due to: a. Heating. b. Rapidity of quenching. The losses due to heating are usually small in the amateur set and, so far as these are concerned, almost any form of gap can be used. The quenching of a gap is determined by:

1. Material of gap. (Copper gaps quench most rapidly.) 2. Gas in which spark takes place. (Hydrogen and illuminating gas produce best results.) 3. Separation of the electrodes. (The gaps should not be closer than .01 inch. The spark should take place in an airtight chamber and the gaps provided with radiating flanges for cooling. In the larger gaps air blasts or water circulation systems are used to facilitate cooling.)

5. Oscillation Transformers.—These coils are really air-core transformers and serve the purpose of transferring the energy of the closed condenser circuit to the open antenna circuit. The preferred type of this transformer takes the form of two concentric, cylindrical coils wound with copper ribbon. It has been shown that by using a rapidly quenching gap and close coupling, a gain of 25 to 40 per cent. over the spark sets is readily possible.

6. Antenna.—The antenna losses may be due to:

a. High Frequency Resistance.—Since the currents in the antenna are of fairly high frequency the aerial should be of stranded wire, thus providing the greatest possible surface for the conductors used. The lead-in should be composed of a cable of the same wire as used in the antenna; the number of them being the same as in the aerial. This method should be followed in all cases.

b. Induction in Neighboring Masses of Metal.—Guy wires are very liable to give trouble in this direction unless broken up into short lengths by means of insulators.

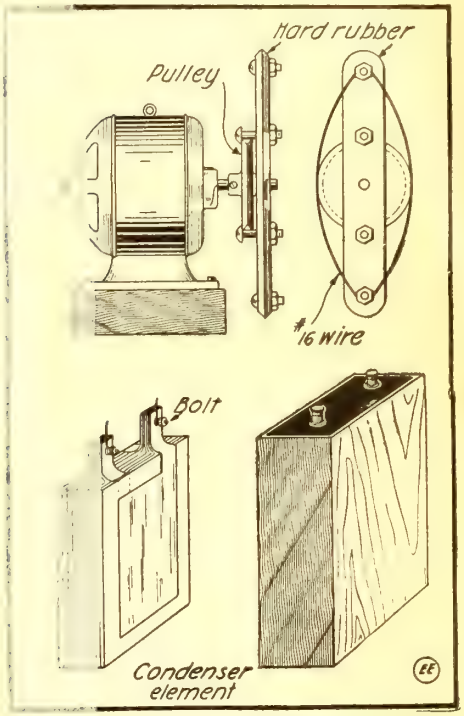
c. Leakage Through Faulty Insulators.—This form of loss is only too well known and can only be remedied by using better insulators.

d. Brush Discharge from Aerial.—This form of loss was referred to under "Condenser Losses." It may be avoided by having no sharp ends or bends in the aerial wires and by having the "open" end of the antenna heavily insulated (since the voltage is higher at the farther end of the antenna). Use curved joints in all parts of the antenna, not square bends.

e. High Resistance Ground.—This is a

(*Continued on page* 728.)

p and some paraffine melted and in. A piece of hard rubber is fitted mouth of the jar and two binding mounted on same for connections. Several of these can be made up to form ustable condenser. Paraffine oil is



Spark Gap and Condenser Kinks.

ed in such condensers instead of

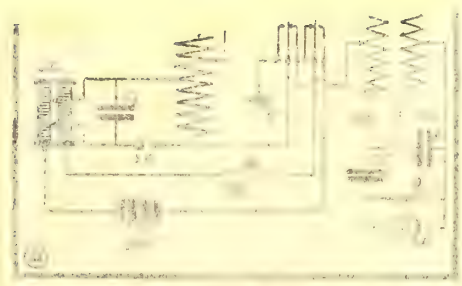
an illustration showing a novel vhich to mount the revolving mem- a "Marconi type" rotary spark gap have made and know to be efficient. is type of gap it is easy to obtain ed on account of the lightness of ting arm. I think the sketch is lanatory. With a small motor it good, high pitched spark on only lts. Would suggest that 12 sta- studs be used mounted in a hard ber ring. The hard rubber used can be rom an old storage battery jar.

tributed by

RAYMOND H. CAMPBELL.

AMALGAM RECIPES.

Tin and mercury combine readily at or- temperatures. If 3 parts mercury ght into contact with 1 of tin 6- rystals of tin amalgam are formed. algam is used for silvering looking glasses. When pulverized and rubbed on the polishing stone it forms a kind of mosaic silver. Electric amalgam may be made by melting tin and zinc together in various proportions in a porcelain crucible. The xture is well stirred up, and when on the point of solidifying the mercury is added and worked into the mass. The which is next transferred to a mortar enough to keep the amalgam soft, it is well worked together, after a piece of tallow or lard, not quite n bulk to the mass, is kneaded in the amalgam attains the proper con- y.

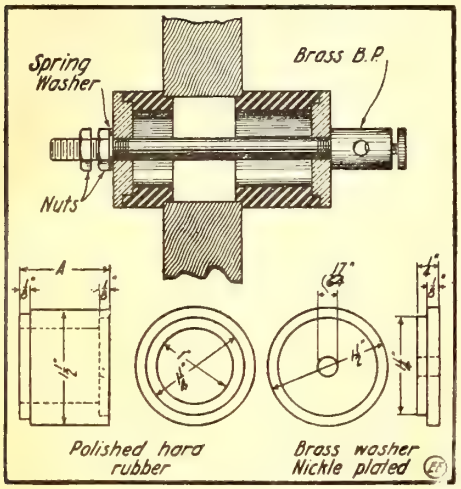


A compact fit snugly in the

dered Alum in strong *Vinegar, Oil tar or* fine *Emery* are often used to e rust. *Kerosene* or *Turpentine,* if the stained or rusted portions over will sufficiently soften the rust so that it may be removed by the use of fine cloth followed by a polishing er.

HIGH TENSION LEAD-OUT.

This lead-out terminal post is intended for use on radio transformers and condensers, but, of course, it may be used in any other place as a high tension bushing. It consists of hard rubber tubing 1½ inches in diameter and with a ¼-inch wall. The drawing needs little explanation. The dimension A should be whatever the diameter



Hard Rubber Tube Forms Efficient Lead-Out Insulator.

of the hard rubber is, in this case 1½ inches. The short piece should be one-half of the length of the outside one. The hard rubber tubing should be machined as per drawing, and the binding post and outside brass washer should be nickel-plated.

The brass rod should be threaded into the end of the binding post and fitted with two hexagon nuts and a spring washer. The rod should be of such length as to tightly clamp the hard rubber pieces as shown. In the assembled drawing is seen the lead-out complete, mounted presumably in a condenser or transformer base.

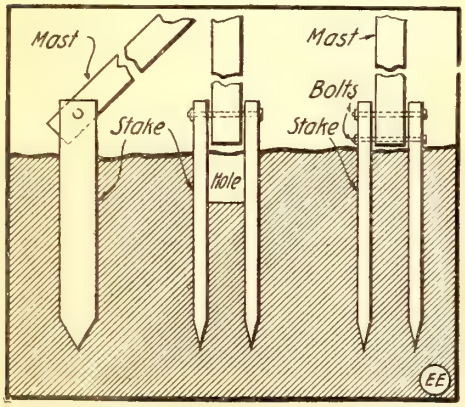
This insulator is easily made, is highly efficient and will add a "commercial" touch to any amateur equipment.

Contributed by
THOMAS W. F. DRURY.

HOW TO ERECT AN AERIAL MAST.

Many amateurs have great difficulty in raising an aerial mast. The method here described practically eliminates all difficulty.

Drive two five-foot wooden stakes into



Erecting an Aerial Mast.

the ground so that but one foot of each projects. The space between the stakes should be a little more than the thickness of the mast. Then dig a hole, in which the mast is to be placed when erected, between the two stakes. Drill half inch holes in both stakes as well as in the

QUEEN DECORATES WIRELESS OPERATOR.

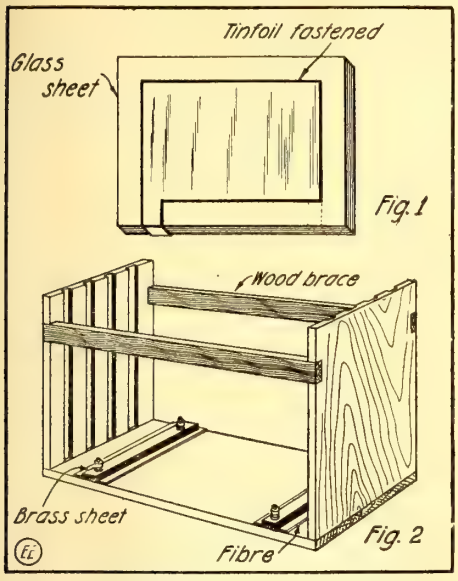
Arthur Hankin, a former Trempealeau, Minn., boy, who until a few months ago was a wireless operator aboard a British warship in the Far East, is convalescing in a hospital in England after a long illness. Writing from the hospital, he tells how he was recently decorated by Queen Mary with a slip of heather. He says:

"I had the pleasure of shaking hands with King George of England and Queen Mary. Also, they both wished me a speedy recovery. The king and the queen arrived at the hospital early in the day and we were lined up to receive them. They came to each of us and shook our hands and asked about our experiences and where we had been stationed.

"The queen's lady-in-waiting had a bundle of white heather, and the queen handed each officer a piece, and she was kind enough to say she hoped it would be lucky to us."

TRANSMITTING CONDENSER CONSTRUCTION.

Below are shown details for constructing a useful and efficient form of the glass plate transmitting condenser for radio sets. The slide plates are readily remov-



Rack for Holding and Automatically Connecting Glass Condenser Plates.

able from the frame, as will be perceived, so as to make it of any capacity desired. Fig. 1 shows how the glass plates are coated on both sides with two tinfoil sheets. As is the usual plan, the lug from each sheet is carried down to the edge of the glass and passed across this edge in the manner shown. Now by glancing at Fig. 2 it is apparent how the alternating tinfoil on opposite sides of the glass plates are connected with the circuit at the plate edge as they are slipped into the frame, where the foil lugs rest on metallic strips at the base of the frame proper.

The frame itself may be constructed of wax-impregnated wood, or of fiber, hard rubber, etc. Photographic negatives make good condenser plates, as they are usually quite free from air holes. To remove the gelatine from the surface all that is necessary is to soak them in hot water for a few minutes, when the coating can be easily scraped off.

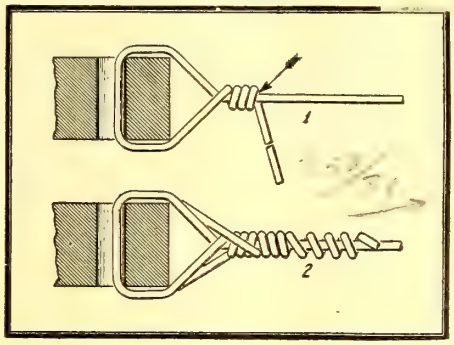
Contributed by [illegible]

ALUMINUM WIRE FOR AERIALS.

My small antenna for 200-meter waves was composed of six No. 14 aluminum wires, fastened to heavy 17-foot spreaders. When it had been up about a month one of the wires broke at the spreader. A few days later another broke at the same point. This was followed by a break at one of the porcelain cleat insulators. Then I decided to make some changes. When I first fastened the wires to the spreaders and insulators I did it in the manner shown by Fig. 1 of the drawing. With copper wire no break would have occurred but aluminum wire cannot be bent many times without breaking it. The spreader, as it swung up and down in the wind, bent the wire, though slightly, at the point marked by the arrow. When I fastened the wires again I used the method shown at Fig. 2. I passed the wire around the spreader, or through the hole in the insulator twice and did not twist it as closely as in the first case. This left no sharp stop where the wire could bend. It also strengthened the wire at the point of greatest strain.

I also put on new spreaders of cypress one inch square and nine feet long. Cypress is strong, light and withstands the weather better than other woods. Later I took off two of the wires. When using four wires, instead of six, there is no difference in the strength of the signals in receiving. I am heard by other stations just as lou[illegible] too. The antenna worked no better with [illegible]ore wires spaced farther apart.

I found the lead-in wires were s[illegible] oxidized at the joints where the [illegible]a soaked through the tape—the join[illegible]



Method of Making Joints in Aluminum Wire Aerials.

not been soldered. In place of the tape I put on paraffined cloth. The cloth was simply run through the melted paraffin twice. After winding a few turns of wire around the cloth-covered joint I heated it with a match to remelt the paraffin inside. This made the joint watertight without the trouble that soldering entails. The aerial has been up five months without giving any trouble.

[NOTE.—On account of the above and similar troubles, aluminum wire for aerials is not used any longer in modern wireless stations, phosphor bronze, or the so-called "copper-clad" or "antenium" wire being used exclusively now. It is cheaper and better than aluminum.—EDITOR.]

Contributed by
MILTON B. SLEEPER.

RECEIVES RADIO FARTHEST IN DARK.

I find that when receiving weak radio signals that by making the room dark the signals seem to come in much louder. The reason for this is that in a dark room you cannot see and therefore your sense of hearing is much keener.

Contributed by M. STIENER.

[This is a fact not at once conceivable perhaps, but on reflection it is seen that if we do not tax the other senses, such as sight, that the sensitiveness of the ear is readily augmented.—EDITOR.]

TRUCTOR



d Construction of a Decremeter

Part II.—Conclusion

By Milton B. Sleeper

Assembling the Decremeter.

First fasten the coils in the case with the brass straps. Next, screw the parts on the front. See that the switch is in proper alignment with the pointer; make sure that the condenser plates do not touch; have the slider moving smoothly in the slot. No dimensions for the detector have been given, as any good model will do. The stand in Figs. 1 and 4 is of a very convenient design, however.

Fig. 10 shows how the connecting wires are run on the back of the hard-rubber panel. Use heavy, stranded, flexible rubber covered wire. *Small wires increase the damping of the instrument.* If the damping is too large the meter will be inaccurate. Leave enough wire on the switch connections, to allow the contacts to move freely. Before screwing the front to the case go over the connections; be sure that they are exactly right. With everything adjusted, the meter is ready for use.

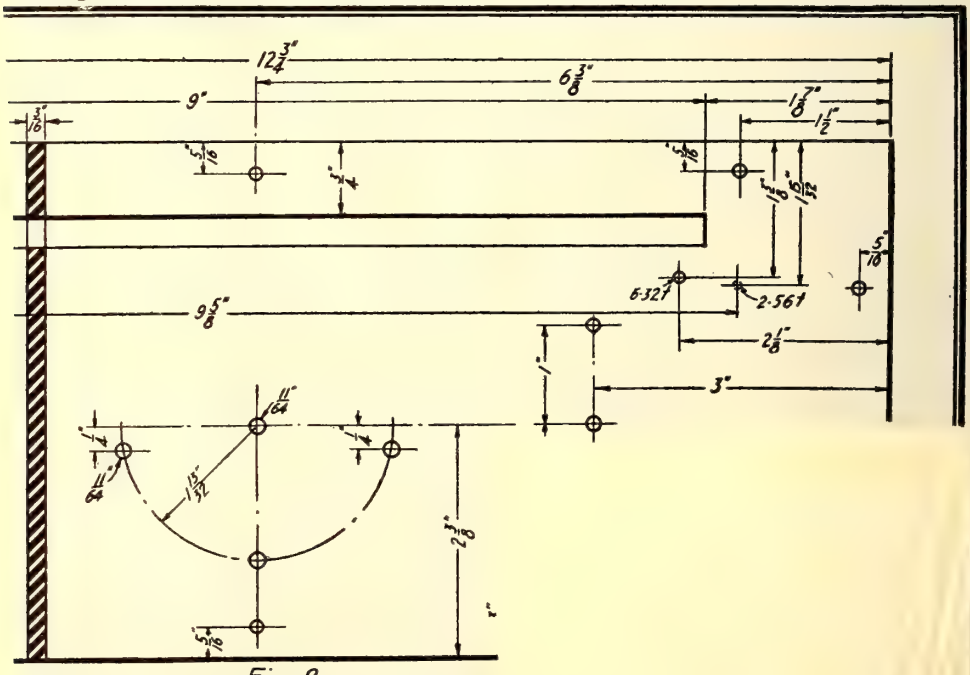


Fig. 8

of Decremeter Switch Panel, Showing Dimension

Use of the Decremeter.

Some understanding of the principles of the decremeter are necessary if the instrument is to be intelligently used. In Fig. 11 the circuit 1-2-3-4 resembles that of a decremeter as well as that of a wave meter. V. Bjerknes has proved that when this circuit is tuned to a transmitting set,

$$\delta = \pi\left(1 - \frac{\lambda}{\lambda_1}\right)\frac{1}{\sqrt{\left(\frac{n_1}{n}\right)^2 - 1}};$$

where:—

δ = decrement of the transmitter,

λ = wave length of the transmitter,

n = number of turns in 'phone circuit, when faint signals are heard,

λ_1 = wave length of circuit when it has been changed a small amount from that of the transmitter,

n_1 = number of turns in the 'phone circuit required to bring signals back to their former strength.

When the switch is in position 1, as indicated by the pointer, Fig. 1, or in position 3-4, of the back views, the small coil is in series with the long coil and condenser. The 'phone is connected across 26 turns of the long coil. Now, if the condenser is adjusted to put the circuit in resonance with the transmitter.

λ = wave length of the transmitter, and

$n = 26$ turns.

To summarize the operations in finding the decrement of a transmitter:—

1. Put the switch in position 1.
2. Place the meter about five feet from the helix.
3. Adjust the detector until sounds are heard in the 'phone when the key is pressed.
4. Turn the condenser until signals are loudest. *Do not touch the condenser again.*
5. Move the decremeter away from the transmitter until the signals are barely audible.
6. Change the switch to position 2.
7. Adjust the slider until the signals are *exactly* as loud as they were before the switch was changed.
8. The decrement of the transmitter will be indicated beneath the pointer on the scale.

Fig. 9. Details of Decremeter Case. To be made preferably of hard wood, well polished, such as mahogany or quarter-sawed oak. Three coats of shellac or varnish, each rubbed smooth with pulverized rottenstone and linseed oil, will yield a fine, glossy finish.

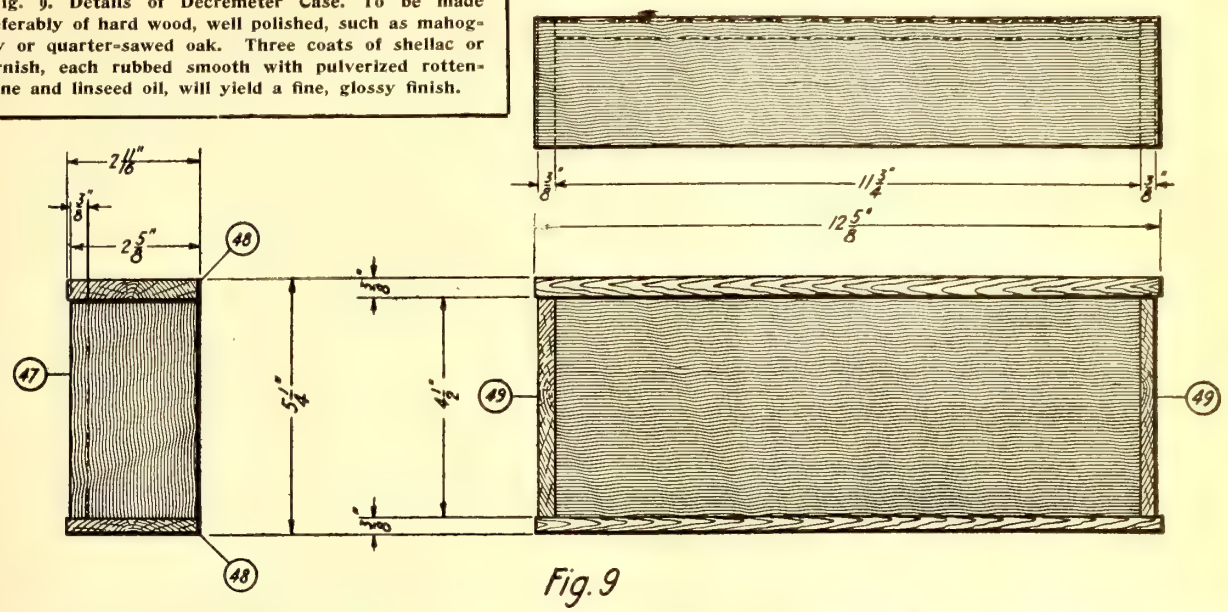


Fig. 9

Tuning a Transmitter with a Decremeter.

The decrementer can be used for a number of practical purposes. A decremeter can be used as a wave meter; the wave length being read from the condenser scale. In this case have the meter calibrated when the slider is at the extreme right and the switch in position 2. Always adjust it in this way when using it as a wave meter. Before measuring the decrement of a set always be sure that the wave lengths of the closed and open circuits are the same. If the meter is not calibrated to read as a wave meter it can still be used to bring the circuits into resonance. The method is as follows:—

1. Disconnect the antenna and ground from the oscillation transformer or helix.
2. Adjust the closed circuit for maximum efficiency with a hot wire ammeter or by the appearance of the spark.
3. Put the meter a few feet from the set. With the switch in position 2, adjust the slider roughly, and finally the condenser, for a maximum response in the 'phones when the key is pressed. *Do not change the slider again.* Note the reading of the condenser.
4. Connect the antenna and ground. Disconnect the closed circuit from the helix. In the ground lead insert a spark coil or buzzer to excite the antenna.
5. Adjust the clips until the maximum response in the 'phone is at the same position on the condenser scale as with the closed circuit. Now the two circuits will have the same wave length.

When the circuits are in resonance adjust the coupling until the hot wire ammeter in the antenna indicates a maximum radiation, or until the signals are heard loudest at a near-by station. At this point *measure the decrement.* If it is too large, separate the coils of the oscillation transformer, even though the radiation is decreased, until the decrement is 0.2. If the decrement is so high that it cannot be sufficiently reduced by loosening the coupling, without greatly reducing the radiation, there is something wrong with the construction of the set. The two circuits must be out of resonance, the resistance of the antenna must be too large, the ground connection poor, or the spark gap may be at fault. Any form of resistance in the antenna circuit will increase the decrement.

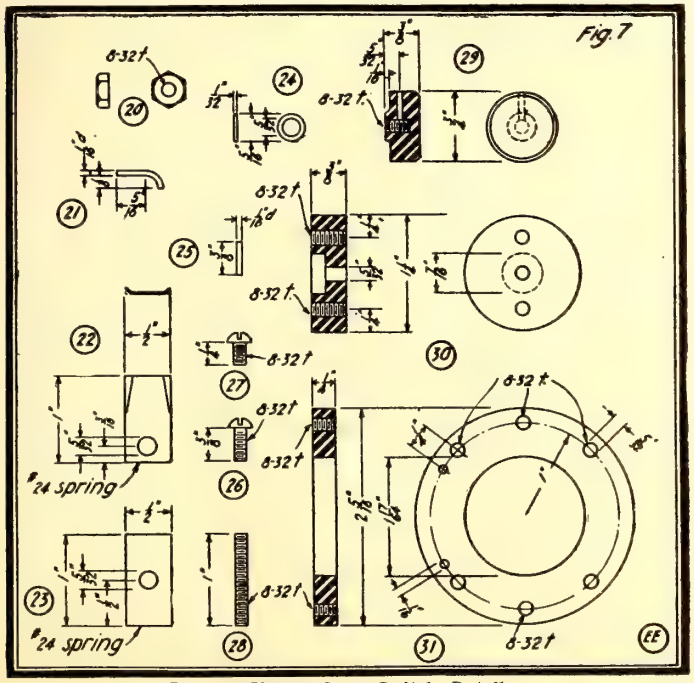


Fig. 7. Change-Over Switch Details.

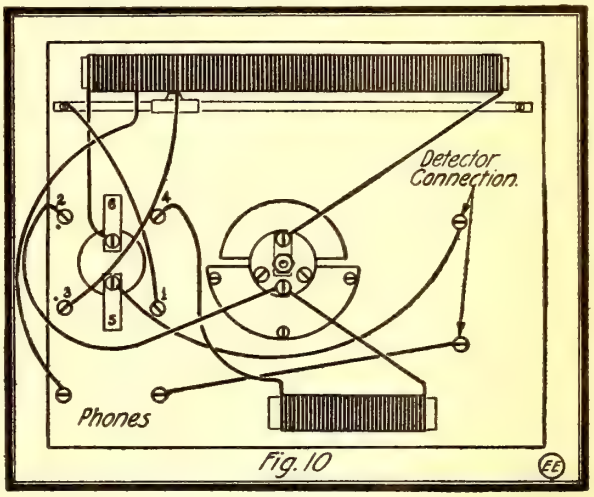


Fig. 10. How Parts of Decremeter Are Connected.

It is interesting and very useful to calibrate the decrement of the transmitter on a scale fitted to the oscillation transformer frame. If the station is equipped with a wave meter, the two radiated waves can be measured and set down beside each decrement reading. The decrement of a transmitter will change slightly in wet weather, or when the spark gap is changed. It is convenient, when calling a station to increase the decrement, or broaden the wave, by moving the coils of the oscillation transformer nearer together. This interfering wave will be heard by the station called, even though it is tuned to a wave higher than 200 meters. *After an acknowledgment has been received, reduce the decrement to the legal limit.* During interference the

decrement can be further reduced, if necessary, for the lower the decrement, the more sharply a station can be tuned at the receiving set.

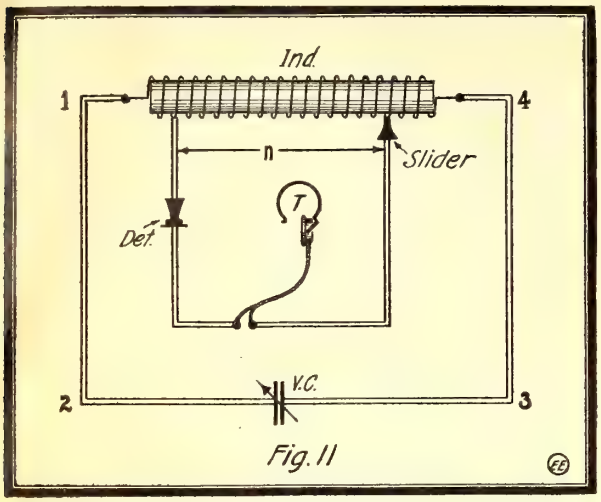


Fig. 11. Hook-up for Decremeter. (Schematic.)

If the decremeter is calibrated to read as a wave meter it is possible to plot a curve representing the tuning characteristics of the radiated wave in the following way: Put the switch in position 2. Adjust the condenser to a wave length below that of the transmitter, and move the slider to the left until the signals are barely audible in the 'phone, when the key is pressed. On a piece of cross-section paper measure up from the bottom a distance to represent the number of 1/100ths on the scale. Move the condenser to a position 10 meters higher. Again find out the number of turns required to make the signals just audible. Measure a distance to the right of the first line to represent the increase in wave length, and upward a distance to represent the number of scale divisions now indicated by the pointer on the slider. Plot a number of points in this manner, both above and below the wave length of the transmitter. Then connect these points by a smooth curve. If the decrement is small, and if the set can be sharply tuned at a receiving station, the curve will be quite sharply peaked.

The decremeter described in this article, particularly when calibrated as a wave meter, is one of the most useful pieces of auxiliary apparatus for any radio station. It is hoped that this description of the instrument will help to popularize the decremeter with experimenters by clearing up some of the points not understood about its construction and use.

AIR-INSULATED TESLA COIL.

Experimenters who have wireless sending stations have all the apparatus necessary for the operation of an air-insulated Tesla coil.

The coil here described is suitable for use with spark coils giving from a 2-inch to 6-inch spark or with a ¼-kw. transformer.

The coil described in this article will give a 7½-inch spark when used in connection with a ¼-kw. closed core transformer (magnetic leakage type), glass plate condenser and a rotary spark gap. When a stationary gap is used the sparking distance is about 5 inches.

The illustration gives the necessary dimensions and shows part of the primary and secondard tubes cut away to bring out various points in the construction.

The primary consists of 21 turns of No. 14 B. & S. gauge rubber-insulated wire wound on a paper or fiber tube 6 inches outside diameter. This tube is easily made from a pasteboard box, which may be procured at any grocery store. This is also true of the secondary tube. The length of the primary tube is not shown in the illustration because there is a great variation in the thickness of the insulation of the different kinds of wire. There should be just enough space between the end pieces to accommodate 21 turns of the wire used. If No. 14 D. R. C. wire, which is almost ¼ inch in diameter, similar to that for electric light wiring, is used the space on the tube should be about 4 inches for 21 turns. This wire can usually be obtained, although stranded wire is preferable.

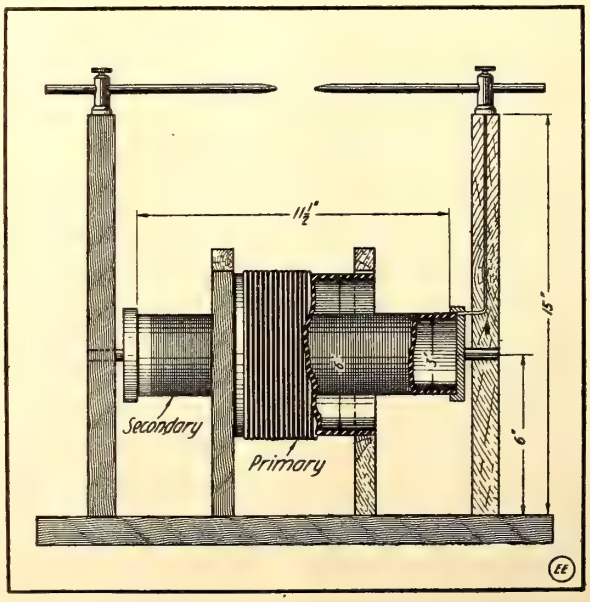
The secondary coil consists of one layer of No. 32 B. & S. gauge enameled or D. S. C. wire (cotton-covered may be used) wound on a tube 3 inches outside diameter. The winding should be 11½ inches long. The base and woodwork may be of any size the builder desires. The posts, however, must not be lower than indicated or the spark will jump into the primary winding.

The framework may be made of most any hardwood, or it can be made of poplar, but hard pine should not be used. The coil should be put together entirely with wooden dowels, because if nails or screws are used the sparks will jump into them.

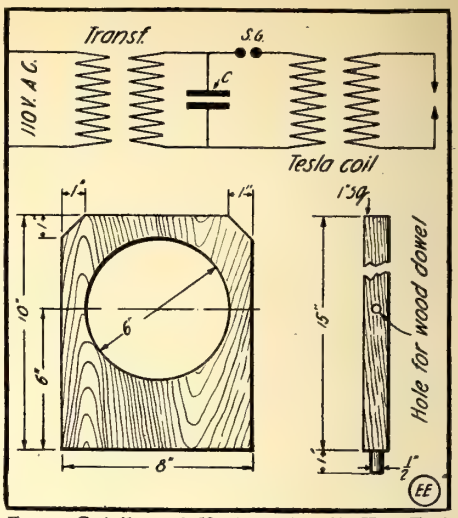
The posts may be forced into half-inch or larger holes bored in the base to receive them and should be held with glue. The tubes may be fastened to the end pieces with glue, but it is preferable to fasten the larger tube into its end pieces by cutting a hole in each piece just large enough to allow the tube to slip into each end and fit snugly. See illustration showing the construction of these end pieces.

Holes may be bored in the base and in the end pieces to fasten them together with wooden dowels and glue. This is accomplished as easily as by using screws.

The next thing is to fasten the secondary into place. The best way to do this is to insert the two dowels projecting from the end of the secondary into the two holes bored in the upright posts to receive them and gently drive both posts into the holes made in the base for them. This completes the construction of the coil. The woodwork may be finished with any substance that is a *good* insulator.



Well Designed Tesla Coil. Will Give 7 to 8 Inch Spark When Used on ¼ Kw. Radio Transformer.



Frame Details and Hook-up for ¼ Kw. Tesla Coil.

The size of the condenser will depend upon the spark coil or transformer used and will have to be determined by the experimenter. For spark coils of about 2 inches a half-gallon Leyden jar may be used, but with larger coils the number of the jars should be increased until the correct capacity is obtained. This would also be true of plate condensers.

Very beautiful experiments may be performed with this coil in a dark room. The spark may be allowed to jump to a piece of metal held in the hand, but no sensation of pain will be experienced. If the spark jumps directly into the body only a slight burning sensation will be felt.

Lubricating oil may be placed on the end of the finger and lighted by means of the spark without burning the finger.

A very surprising and beautiful, as well as weird, effect may be produced by connecting small cotton-covered magnet wire, No. 32 or smaller, to each terminal of the secondary and leading them off to the side of the room, keeping the wires about a foot or two feet apart. It is, of course, understood that all Tesla experiments should be performed in absolute darkness, as the desired results may be obtained only in this way.

Another experiment is to ground one wire of the Tesla secondary and attach a piece of wire to the other secondary. This will cause an enormous brush effect on the free wire.

Scores of other equally interesting experiments may be carried on, but these the experimenter may easily find out for himself.

The writer will be pleased to hear from those who build this coil.

Contributed by

LEONARD R. CROW.

SOLDERING PASTE.

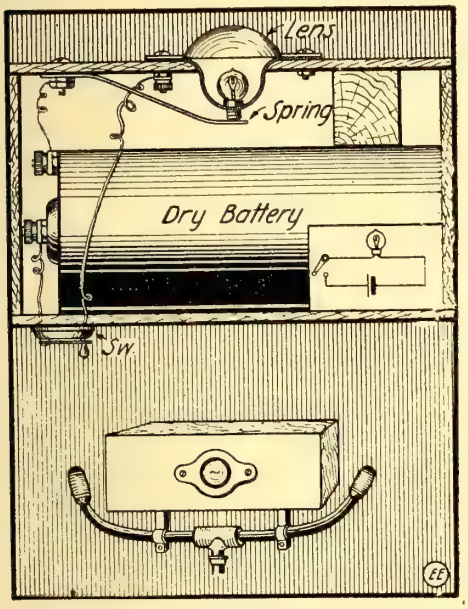
The materials required for making this very satisfactory soldering paste are a 15c. can of "Nokorode" flux, which is a brown substance, an old tooth paste tube or other collapsible tube and some solder. With a coarse file make an amount of solder filings equal to the flux and mix them together. Open the bottom of the collapsible tube and round out the flattened walls, being careful not to tear it. After cleaning it put in the mixture you have made and close the end. The paste may be squeezed out as required. Its action is similar to "Solder-all."

Contributed by OLIVER PARKER.

USEFUL BICYCLE HEAD LAMP.

This idea is original as far as I know, the light and battery being self-contained and mounted on the handle bars. I can imagine that this piece of apparatus will make quite a hit with those fellows owning an up-to-date bicycle built along motorcycle lines. I will not give dimensions as I believe each constructor will follow his own particular ideas. A box is constructed such that will give the battery a snug fit, so as to eliminate movement. A flashlight is procured, one of the pocket type. A very cheap flashlight will suit. Cut out the parts, as shown, the correct size and lines being left to the constructor. Mount this, as shown, on the proposed front of the box. A piece of spring metal connects the bottom contact of the lamp. A switch is mounted on the side nearest the rider, preferably one with removable blade such as the Keystone switch, so that no one will tamper with the light when the rider is otherwise occupied. The cover may be provided with hinges or screwed on. A block of wood wedges the battery in the case tight. Purchase from a bicycle supply store two frame pump holders, which will cost a few cents. Cut as shown and screw onto the box, mounting same on handle bars, as indicated. The diagrams, I think, are self explanatory.

Contributed by W. J. ADAMS.



Bicycle Head Lamp Made to Use Standard Dry Cell.

HOW TO MAKE AN ELECTRIC THERMOMETER.

The experimenter who is intensely interested in general research work should not by any means miss an electric thermometer in his laboratory. The commercial thermometers of this class are very expensive, and this is one reason why the experimenter generally lacks such an instrument. The Pyrometer, as it is technically called, and herewith described, was built by the writer, who used it successfully in connection with an electric furnace developing 2,000 degrees Fahrenheit.

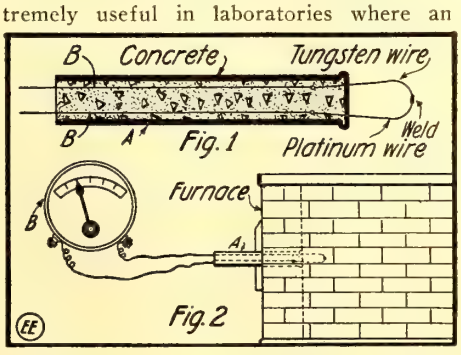
The detecting apparatus consists of a thermo-couple made especially for high temperature. The first thing is to obtain a short piece of No. 20 platinum wire about 2 inches long and a piece of tungsten wire of the same gauge and length. One end of each piece should be welded together to form a single long strip. This can be readily accomplished by splicing them together and heating to a bright redness in a Bunsen burner, or still better, in an oxy-acetylene gas burner. After this is done two long copper wires B B are next welded onto each end of the loop, Fig. 1. The welding is done in the some manner as with the other two wires, but care should be taken not to heat them too long, as the copper ones are apt to fuse on account of the low melting point of copper compared with tungsten and platinum. The wires are now placed in an 8-inch porcelain tube, which is then filled with a concrete mixture, or even better, with lime (calcium carbonate), saturated in water and allowed to dry. This mixture keeps the wires in place and at the same time will keep the interior wires from overheating during the use of this apparatus.

The recording device B, Fig. 2, consists of an ordinary milli-voltmeter with a scale calibrated in *degrees* instead of in millivolts. The scale should be removed and another scale without any figures or marks replaced. It is now ready to be calibrated. Both instruments should be connected as shown in Fig. 2. The detecting apparatus is placed in a furnace giving a temperature averaging about 200 to 300 degrees Centigrade; then carefully insert a standard mercury thermometer into the same furnace. The standard must read 300 or more degrees, as the temperature of the furnace will cause the mercury to reach its limit until it will force itself through the bulb, thus damaging the instrument. Read the scale on the mercury thermometer and note the deflection of the pointer on the milli-voltmeter scale. Mark off a point and, if possible, increase the temperature of the furnace and take another reading, marking another scale point. The figure obtained on the standard should be noted on the scale of the unknown. Marking these two points, the rest of the scale is equally divided and spaced according to the divisions previously found. It should read to 2,000 degrees.

For those who are not familiar with the operation of this instrument, a few words will suffice. Whenever any two dissimilar metals connected together are heated or cooled below the temperature surrounding these conductors a current of electricity is set up, which in turn registers on the millivoltmeter scale. The current produced by the thermo-couple is directly proportional to the heat produced by the furnace; therefore heating the two wires with a greater temperature produces a greater deflection on the indicating device, etc.

Having completed the outfit, the instrument is now ready for actual use. This electric thermometer will be found extremely useful in laboratories where an electric furnace is used for producing refractory substances and artificial gems.

Contributed by S. CROW.



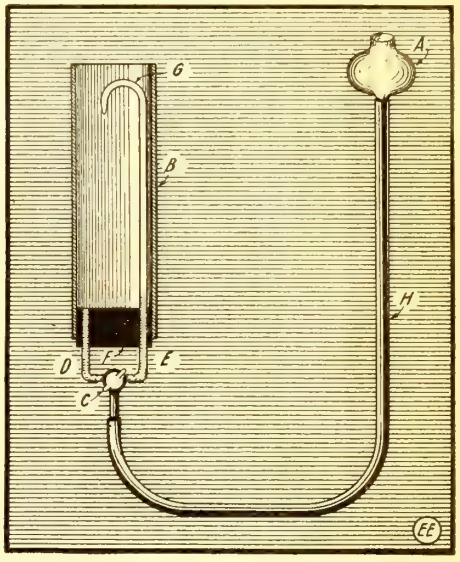
Electric Thermometer Parts and Use of Same in Furnace.

Are you a contributor to this department of The Electrical Experimenter. If not—why not?

CLEANSING MERCURY BY WASHING.

While distillation under reduced pressure is the most satisfactory method of removing impurities from mercury, it is often sufficient to wash thoroughly with diluted nitric acid. As usually performed this is rather a mussy undertaking, but by means of the apparatus illustrated on this page the trouble is reduced to a minimum.

The washer consists of a mercury reservoir A and a tall glass tube B open at both ends, the capacity of the latter being several times that of the former. A three-way tap C is also required. Two of the side tubes D and E are bent upward and passed through an India-rubber cork F, closing the lower end of the large tube. To one of these is attached the glass tube G, which reaches almost to the top of the wide tube and is bent downward and drawn to a fine jet at the end. The other tube D should be flush with the cork. A length of pressure tube H makes a flexible connection between the reservoir and the tap.



Mercury Cleansing Scheme.

The soiled mercury having been placed in the reservoir A, and a quantity of diluted nitric acid in the wide tube B, the action proceeds as follows: Upon raising the reservoir to the position shown in the illustration and putting it in communication with the tube G by means of the three-way tap, a thin stream of mercury will pass through the column of acid, collecting at the bottom of the tube. The reservoir may then be lowered as far as it will go and the tap adjusted so that the mercury flows back through D. The operation should be repeated several times to insure thorough cleansing, the reservoir being supported in the upper and lower positions respectively by means of a wire cradle and hooks, or in any other convenient manner. The mercury should afterward be washed in clear water and dried by heating in a glass or porcelain basin to just above the boiling point of water. Contributed by

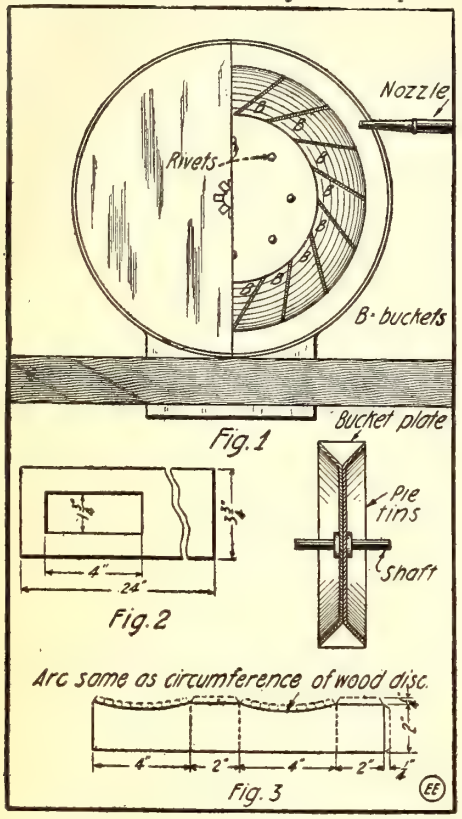
H. J. GRAY.

Don't test storage cells with an ammeter. It forms a complete short circuit and will eventually ruin the cells. Use a voltmeter. Don't use lighted matches to examine storage cells. The gas given off forms an explosive mixture.

Safety first—don't handle electric wires even though they are 'phone wires. They may have become crossed with a high voltage transmission line, which means instant death.

A HANDY HOME-MADE WATER MOTOR.

A very useful water motor that will run a small dynamo or a sewing machine on a pressure of about 30 pounds water pressure can be made at a very small expense.



A Home-Made Water Motor for Experimenters.

Procure two 7-inch flaring edge pie plates 1 inch deep. Find the exact center and punch a pin hole through the bottom of each plate. Place the plates with their bottoms together and hold their centers in line by placing a pin through the holes. Rivet the plates together, using eight rivets spaced equal distances apart on a circle 4 inches in diameter. Then solder the joint all the way around the plates.

Cut 16 triangular pieces of tin to fit between the edges of the plates (see sketch). Solder them at uniform intervals around the plates, between the diverging edges. These form the buckets and should be placed at an angle, as shown in Fig. 1.

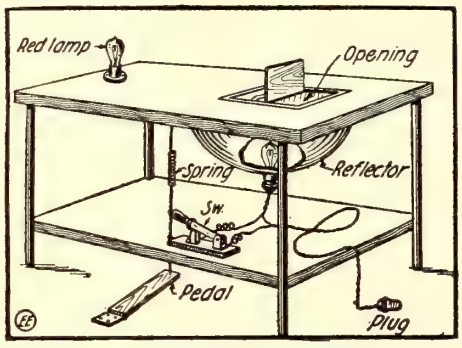
After the buckets have been finished drill a ¼-inch hole through the center of the pie plates for the shaft. Slip a ¼-inch brass rod through the hole and solder it in place. *Be sure that the rod is perpendicular to the plane of the wheel.* The shaft should be at least 6 inches long. Solder a brass thrust collar ¼ inch thick and ⅝ inch from the bottom of the plates on the shaft. There should be one on each side of the wheel. Now saw out two round hard wood discs of wood ½ inch thick and 7½ inches in diameter. Boil them in paraffine to make them waterproof. Drill a hole through the center of each, just large enough to admit the bearing. The bearings are made of brass tubing having an inside diameter of ¼ inch. Take a piece 1 inch long and with a hack saw cut six slots in one end ⅜ inch deep. Then bend out the end of the tube at right angles to itself. Make two bearings in this way and fasten one in each wooden disc with screws. Next cut out a piece of tin 24 inches long by 3¾ inches wide In the center of same cut a hole 4 inches by 1¾ inches, as shown in Fig. 2.

Punch holes 1 inch apart and ¼ inch from the edge on each of the long sides. Wrap the tin around the edge of one of the wooden discs and tack it tightly in place. Then place a brass washer on each end of the shaft and put the wheel in place. Now slip on the other disc and tack the tin to it. Solder the place where the ends of the tin overlap. Next cut out a piece of tin the size and shape shown in Fig. 3 for the spillway. Fold the tin on the vertical dotted lines and solder the overlapping ends. Bend the edges at right angles and place the spillway over the bottom hole in the cylindrical casing. Solder it carefully in place. The nozzle is made of an oil-can spout, cut off so that the hole is about ¼ inch in diameter at the smaller end. Solder the spout to a hose connection. Now drill a hole in the center of the casing as in Fig. 1. Connect the nozzle to the faucet by means of a short length of hose and turn on the water. Ascertain the position of the nozzle where the maximum speed is obtained, then solder it firmly in place. Next cut off one end of the shaft close to the casing. Allow the other end to protrude far enough to hold the pulley. The pulley may be of the flat or "V" grooved type and can be fastened to the shaft with a wedge key or set screw. The pulley should not be over 2½ inches in diameter. Contributed by

KENNETH KRUGER.

A PRINTING TABLE FOR AMATEUR PHOTOGRAPHERS.

A very convenient printing table for the amateur photographer may be made as follows: Any table may be used, but one with



An All-Around Electrically Lighted Printing Table for Photographers.

a lower shelf between the four legs of the table is desirable. First cut a hole in the top of the table just large enough for the printing frame to slip in. Strips of thin wood are tacked to the under side of the table top, so that the printing frame rests upon them. A single-pole, single-throw knife switch is next mounted on the shelf underneath the table. To the blade of the switch is fastened one end of a coiled spring. (An old curtain spring will do). The other end of the spring is then fastened to the under side of the table top and adjusted so that the switch is normally open-circuited. A st.ing is then fastened to the handle of the switch blade and run through a small hole in the shelf to a suitable foot treadle made of wood. One end of the foot board is hinged to the floor and the other end is held a few inches above the floor by the string attached to the switch blade.

An incandescent lamp of the desired candlepower is stationed directly beneath the printing frame and about 10 inches from same. A good reflector, such as a tin basin, will add to the intensity of the light. It is best to white enamel the inside of the reflector. When the foot plate is depressed it closes the circuit through the switch and lights the lamp. Upon releasing the pressure on the treadle the spring causes the switch to become open-circuited, thus extinguishing the light. By means of this arrangement both hands are left free for the printing operations. A red lamp may be kept constantly burning over the table if desired. All connections are clearly shown in the diagram.

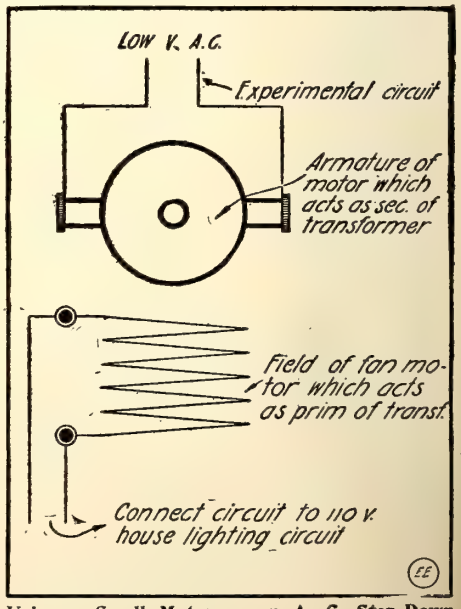
Contributed by

WALTER F. CURRENT.

USING MOTOR AS TRANSFORMER.

The experimenter finds himself oftentimes in need of a transformer to reduce the voltage of the ordinary alternating-current house lighting circuit down to a point where it can safely be used in connection with miniature lamps, bells, small motors and other apparatus. A bell transformer, which is a cheap enough instrument to buy and which, in fact, is quite readily made by anyone who is handy with tools, is just the thing for this purpose, but it sometimes happens that an instrument of the sort is wanted at a moment's notice, and a substitute would thus come in very handy. In such a case it is well to remember that an ordinary shunt wound, direct current fan motor, properly connected to the alternating-current lighting circuit, will serve the purpose of a transformer. Of course it is not as efficient as a device which is wound expressly for the purpose of stepping down the lighting circuit voltage, but nevertheless it can be used and therein lies its chief virtue.

For the purpose it is necessary to use the field circuit of the fan motor as the primary of the transformer. To do this, disconnect the field entirely from the armature circuit and hook it up to the lighting current, as plainly indicated in our illustration. Hook up the apparatus to be run by the low voltage to the brush terminals and it will be found that, with the lighting circuit on, an alternating current at about six volts—it depends a whole lot on the winding of the motor—can be taken from the armature of the fan motor. It is possible to alter the potential of the transformer current slightly by shifting one of the brushes on the commutator, so as to include two or more coils. It is not well to try the experiment with a series wound motor, since neither the resistance nor the inductance in the field of the series motor will be found sufficient to prevent short-circuiting of the house current. Contributed by E. F. HALLOCK.



Using a Small Motor as an A. C. Step-Down Transformer.

USEFUL TELEPHONE HOOK-UPS.

The telephone circuits which are described in this article are those being regularly used by a large telephone manufacturing company and they will undoubtedly prove of value to the young electrician.

Figs. 1 and 2 show two party systems,

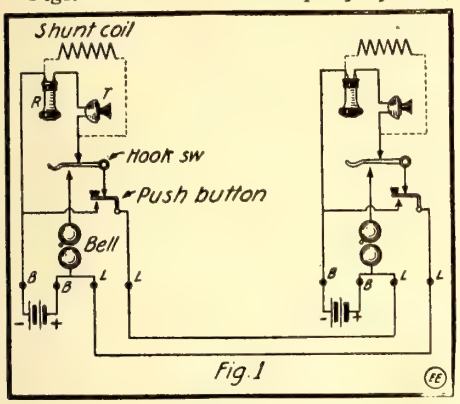


Fig. 1. Hook-up for Plain Series Telephone Set.

one employing two line wires and two sets of batteries and the other utilizing three line wires and but one set of batteries, located at any convenient point between the terminals BB. In case it is desired to use no "call" push button on either of these systems a shunt coil (a small coil of wire) can be bridged across the transmitter and receiver as indicated; its resistance depending on the resistance of the bells. Apparently the transmitter and receiver is short-circuited, but this is not so. When using shunt coils simply connect as shown by the dotted lines and omit the push buttons.

Fig. 3 shows a method by which three to six 'phones can be used on four wires. Inasmuch as all bells ring in multiple, they should be of about the same resistance. Special "code" signals are generally used to call the desired party. Talking is also in multiple, so an impedance coil must be used. An impedance coil is nothing more or less than an electromagnet, in this case being about 14 ohms resistance and is used to keep the direct current from backing up out of the receivers.

The diagram at Fig. 4 depicts a common (multiple) talking, selective ringing cir-

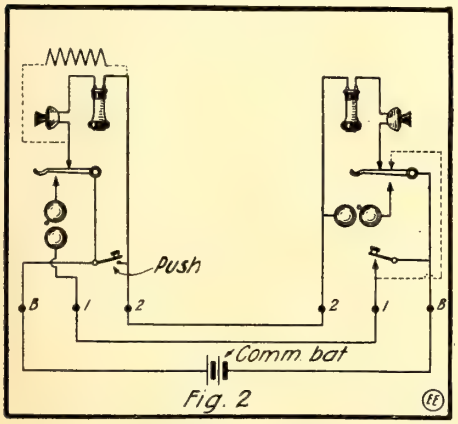


Fig. 2. Simple Battery Telephone System Utilizing Three Wires.

cuit, in which an impedance coil is also used. Any number of telephones can be used on this system, but only one pair at a time. There are always three more wires than telephones and one section wire for each, which must be connected as shown.

The above are about all the connections for which any amateur electrician would find any use, but there are scores of others which would dazzle the eyes of many a young "hope."

In conclusion let me say that wherever a battery call system is used no induction coil is needed, as any direct current that can be used to ring a bell can most certainly be used for talking.

Contributed by LEWIS SCRIVEN.

THE CHEMISTRY OF THE STORAGE BATTERY.

In a brochure issued by the Titan Storage Battery Co., prepared by W. E. Winship, Ph.D., the chemistry of the lead storage battery is well expressed in brief, as follows: The active materials of the lead storage battery, spongy lead and lead peroxide, together with the sulphuric acid and the water of the electrolyte, enter directly into the chemical reaction which takes place on charge and discharge of the battery. (Note particularly that it is chemical energy that is stored in the battery and not electricity as such.)

On discharge, the spongy lead and lead peroxide are converted into lead sulphate at the expense of some of the sulphuric

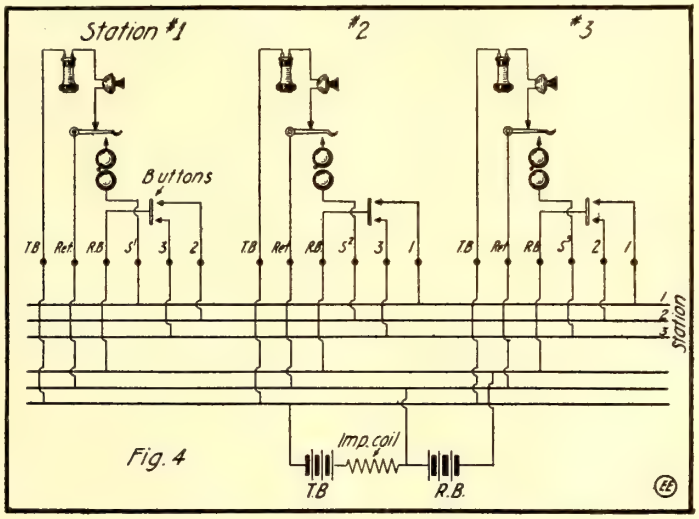


Fig. 4. Common Talking, Selective Ringing Telephone Hook-up.

acid, and in an amount almost exactly proportional to the ampere-hours discharge; while in addition some water is formed, which dilutes and decreases the specific gravity of the electrolyte. The original chemical energy is decreased by an amount equal to the electrical and heat energies developed, the latter being relatively small.

On charge the reverse action takes place, the lead sulphate previously formed on discharge being converted back to spongy lead in the negative plates, and to lead peroxide in the positive plates, a certain amount of water being chemically combined, in again forming the sulphuric acid and lead peroxide.

The lead storage battery, therefore, belongs to that class of batteries which are more or less reversible in their action. It is not completely reversible because of the heat generated and because of other actions described below.

The chemical reactions taking place may be expressed by the following equations:

Reaction at Positive Plate.—(*a*) $PbO_2 + H_2SO_4 = PbSO_4 + H_2O + O$.

Reaction at Negative Plate.—(*b*) $Pb + H_2SO_4 = PbSO_4 + 2H$.

Combined Reaction at Positive and Negative Plates.—(*c*) $PbO_2 + Pb + 2H_2SO_4 = 2PbSO_4 + 2H_2O$.

H ..... Hydrogen
H_2O ..... Water
H_2SO_4 ..... Sulphuric Acid
Pb ..... Spongy Lead
PbO_2 ..... Lead Peroxide

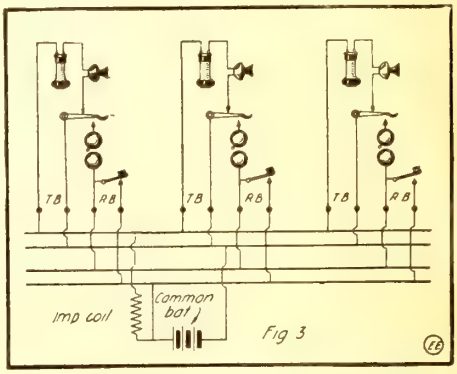


Fig. 3. Multiple Telephone System Using Common Talking and Ringing Wires.

$PbSO_4$ ..... Lead Sulphate
O ..... Oxygen

These equations are the fundamental equations of the lead storage battery.

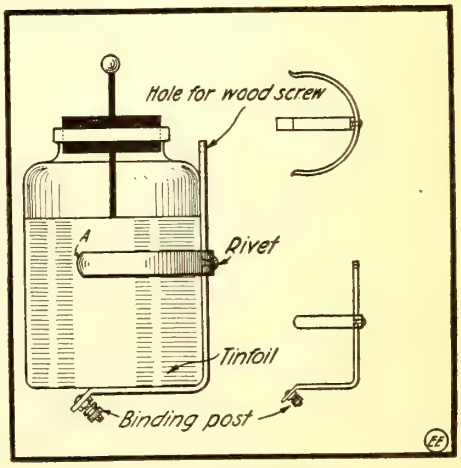
Equation (*c*), read from left to right, is the equation of discharge, and shows the change of spongy lead and lead peroxide on the negative and positive leads, respectively, into lead sulphate and the formation of water from hydrogen and oxygen of the electrolyte. Reading from right to left shows the reactions during charge.

The above reactions are those which normally take place. If impurities are present

(*Continued on page* 733.)

EFFICIENT LEYDEN JAR RACK.

A neat Leyden jar rack is designed as shown in the diagram, so as to prevent the breaking of Leyden jars. The rack is made from spring brass or phosphor bronze stock ½ inch wide and 1-32 inch thick. The length will depend upon the size of the jar and the two strips are riveted together, as shown in the sketch. The end of the horizontal strip is bent at A, so that the tinfoil will not tear when putting the jar in the rack, or vice versa. A number



Simple Rack for Holding Leyden Jars.

of these racks may be fastened to the wall with suitable insulators behind them.

Contributed by FRANK HARAZIM.

HOW TO MAKE IT

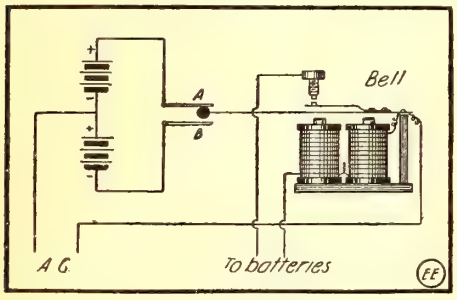
This department will award the following monthly prizes: FIRST PRIZE, $3.00; SECOND PRIZE, $2.00; THIRD PRIZE, $1.00.
The idea of this department is to accomplish new things with old apparatus or old material, and for the most useful, practical and original idea submitted to the Editors of this department, a monthly series of prizes will be awarded. For the best ideas submitted a prize of $3.00 will be given; for the second best idea a $2.00 prize, and for the third best a prize of $1.00. The article need not be very elaborate, and rough sketches are sufficient. We will make the mechanical drawings.

FIRST PRIZE $3.00.

A SIMPLE A. C. CONVERTER.

For performing certain electrical experiments, or in operating certain electrical instruments, such as the Poulsen wireless tikker, telephone bell ringers, etc., it is necessary to use an alternating current.

The instrument here described is quite simple in construction, yet capable of con-



An A. C. Generator Constructed from Ordinary Bell.

verting a direct current into an alternating current (of square wave form) of quite high frequency if properly adjusted.

First procure an electric bell, remove the gong and straighten out the clapper, then fasten it upon a suitable base. Two thin brass strips A and B are now fastened in position, one on either side of the clapper, as illustrated. One brass strip connects to the positive terminal of one set of batteries, while the other brass strip connects to the negative terminal of another set of batteries. These contact strips should be quite close together so that the time interval taken for the striker arm to pass from one contact to the other will be short.

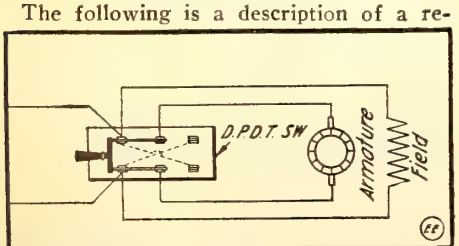
By referring to the wiring diagram it is understood that upon starting the bell the clapper will vibrate from A to B, causing the current to surge first from one set of batteries, then from the other; causing a direct current to be converted into an alternating current.

Contributed by
ARTHUR R. DARLING.

[*Platinum, tungsten or silver contacts should be used on springs and clapper arm for best results.—Ed.*]

REVERSING SWITCH FOR A D.C. MOTOR.

The following is a description of a re-



Reversing Switch for Shunt Wound D. C. Motor.

versing switch for a direct current motor. Take any double-throw knife switch and connect the opposite contacts with well insulated wire. See diagram. The middle contacts are connected to the armature. The diagram is self-explanatory.

Contributed by EDW. CONNELLY.

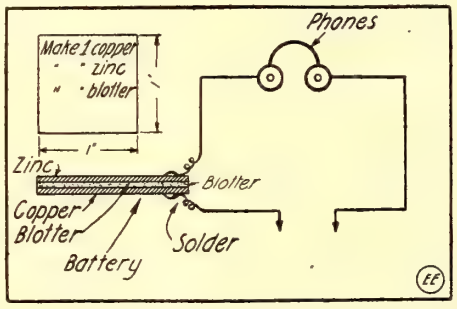
SECOND PRIZE $2.00.

A SIMPLE CIRCUIT TESTER.

The materials required for making this "tester" are a piece of zinc, a piece of blotter and a piece of copper, together with a set of telephone receivers, preferably of about 2,000 ohms resistance.

The dimensions of the zinc, copper and blotter sheets are optional with the builder, but I found that if the pieces are made an inch square the current developed in the battery will be sufficient for ordinary testing purposes. In making the battery it is best to solder a piece of wire onto the copper and zinc before assembling. It is assembled as follows: First saturate the blotter thoroughly with a 20 per cent. solution of chloride of zinc, next place the zinc square on one side of the blotter and the copper square on the other, and finally press the whole together. The battery is now completed, but its life will be prolonged if it is covered with paraffine to keep out the air.

When in use, one of the leads from the battery is attached to one of the tips of a set of 'phones; then if the other tip and terminal are attached to a *closed* circuit a loud click will be heard, but if the circuit is *open* there will be no sound. The "tester,"



Handy Testing Outfit Utilizing 'Phone and Blotter Battery.

if properly made, will save much time and temper in ascertaining whether a circuit is closed or open.

Chloride of zinc is used because it is hygroscopic, i. e., it attracts water, thereby keeping moist for a long time. Besides, chloride of zinc does not attack zinc on open circuit.

Contributed by
J. WALLACE PECKHAM.

A STATIC TRICK.

Static electricity around moving belts in some plants is so pronounced that it is necessary to provide special means for carrying it to the ground.

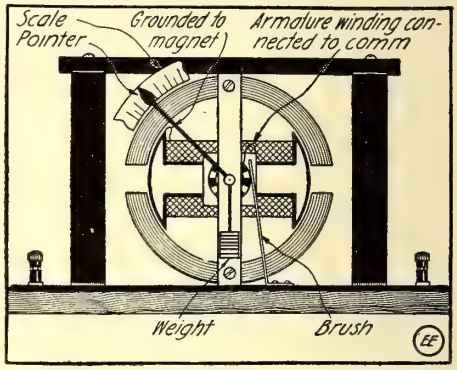
The following is an amusing trick: Hold the base of an electric light bulb close to a moving belt which is generating static. Now approach the innocent victim and offer him the lamp, of course extending the base. The moment he touches the base he will receive a surprise in the nature of a harmless shock. The explanation is simple. The lamp acts as a condenser, the hand holding it being one plate and the filament the other.

Contributed by C. REX GILBERT.

THIRD PRIZE $1.00.

A MOVABLE CORE AMMETER.

This ammeter acts on the principle of the D'Arsonval instruments. An ordinary, permanent steel field magnet motor, of the type illustrated, is used. All that is necessary is to remove one connection and one brush from the commutator; then bind a



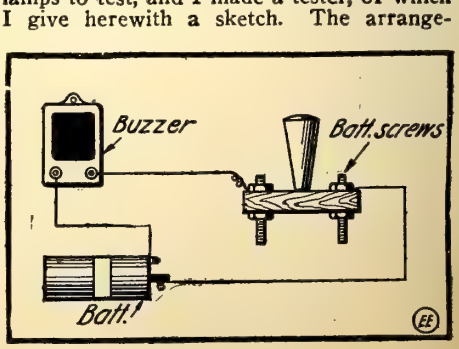
Converting a Small Motor Into an Ammeter.

wire around the latter to make it a conducting ring. Ground the connection which was removed to one of the magnet pillars, then connect the pillar to one binding post. The commutator is connected to the other. A weight on an arm is soldered to one projecting end of the shaft, as also a pointer. This latter is made by hammering flat a piece of No. 18 copper wire at one end; now cut the flattened part to a sharp point. A suitable scale is placed on the instrument which is calibrated by comparison with a standard ammeter.

Contributed by A. D. R. FRASER.

RAPID LAMP AND FUSE TESTER.

Recently I had some fuse plugs and lamps to test, and I made a tester, of which I give herewith a sketch. The arrange-



Rapid Cartridge Fuse Tester.

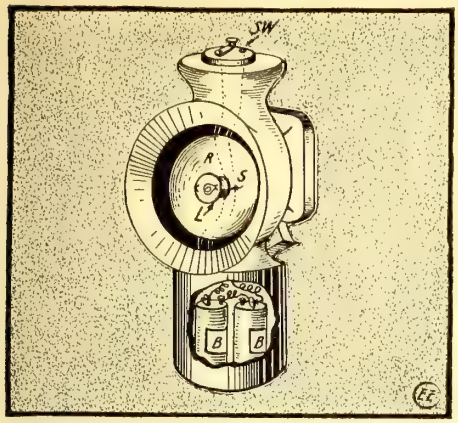
ment is so simple no description is considered necessary.

Contributed by H. S. BOUDEN.

CONVERTING OIL BICYCLE LAMP INTO ELECTRIC.

This is a description of an electric bicycle lamp made from an oil type lamp, as shown in the accompanying sketch.

The materials required are an old



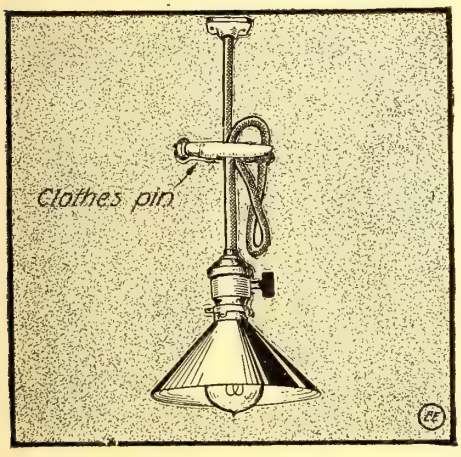
Converting Oil Bicycle Lamp Into Electric.

"Solar" lamp or any oil or gas lamp like that in sketch, a single point switch S W, flashlight batteries B, a miniature socket S, 2.5-volt bulb and some insulated wire. First remove the old burner from lamp, then remove the three small cells from the flashlight battery and cut the case to fit the cells; solder connections to the cells and place them in the bottom of the lamp. Mount the switch on top of lamp and fasten socket to the reflector R. Put the bulb in socket and connect up, as shown in diagram, and lamp is ready for use. It can be used as a bicycle lamp, or, also, it proves handy as a flashlight.

Contributed by CLIFF PINKERTON.

CLOTHES-PIN LAMP CORD ADJUSTER.

Many times, when working in a basement or other place, the electric lamp is in the way, and when a regular cord adjuster is not handy it is very troublesome to have to tie the lamp cord in a knot. The accompanying illustration shows a method that can always be resorted to. The holder shown is a common wood clothes-pin which holds the cord very



A Clothes-Pin Serves as a Lamp Cord Adjuster.

nicely in any desired position.

Contributed by WALTER FRANSEEN.

WIRE AND SHEET-METAL GAUGES.

There are at least eight wire and sheet-metal gauges in use in the United States at the present time, and this gives rise to much confusion and misunderstanding among those not conversant with their use. The following are the principal gauges:

Birmingham or Stubs' iron wire gauges.
American or Brown & Sharp gauge.
Roebling's and Washburn & Moon's gauge.
Stubs' steel wire gauge.
British Imperial Standard wire gauge. (Legal standard in Great Britain since March 1, 1884.)
United States Standard gauge for sheet and plateiron and steel. (Legal standard in the United States since 1893, used in determining duties and taxes.)
Morse drill and steel wire gauge.
Edison or circular mil wire gauge used in electrical work.

These gauges have letters or numbers to correspond to the different sizes of wire or sheet-metal, but as these numbers do not correspond in actual measurement in the different systems, there is likely to be misunderstanding if care is not taken to designate which gauge you are using in making your measurement.

Take any number at random, say No. 5, and it has the following values for diameters or thickness on the different gauges reading in decimals of an inch, .22, .18194, .207, .204, .212, .219, .205; and No. 5 on the Edison gauge would be 70.72 mils diameter for electric wire.

The above comparisons are enough to show the necessity for care in the use of wire and sheet-metal gauges. If you wish to get from the dealer just the size of wire you want, and you have a gauge at hand which corresponds to the size, be sure and name the kind of gauge, as for example, "No. 5 measured by American or Brown & Sharp gauge."

If you have no gauge but have some of the wire such as you want, send the dealer a sample with your order.

If you attempt to measure the wire or sheet-metal with such instruments as you have at hand you probably will have difficulty in doing so as some of the sizes have no variation until the fourth decimal place is reached.—*Gas Review.*

STORING CHEMICALS.

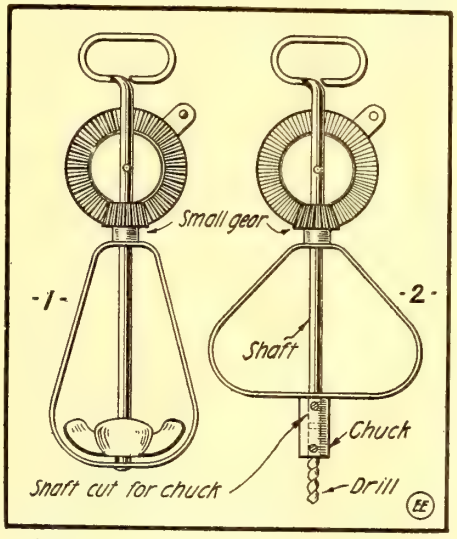
The chemicals used in connection with electrical experiments are for the most part perfectly safe if handled with ordinary care. Acids should always be kept in glass stoppered bottles, since corks are rapidly eaten away to the detriment of the acid, as well as the cork. Dry crystals that are not deliquescent, that is, not absorbing moisture from the air, may be kept in cardboard boxes. Preserve or fruit jars often come in handy for the same purpose.

Deliquescent salts should be kept in glass bottles with wide mouths. Corked bottles that are not likely to be opened for some weeks or months may be made perfectly air tight by dipping the cork for a moment in melted paraffin wax contained in a shallow tin.

Contributed by H. J. GRAY.

A SMALL HAND-DRILL FOR 10 CENTS.

A very efficient hand-drill for light work can be made from a 10 cent egg-beater of the type shown in sketch No. 1. By modifying the egg-beater to look like sketch No. 2 and adding a chuck, made from a piece of tubing with two set screws in it, or a connector for wires, you will have an efficient,

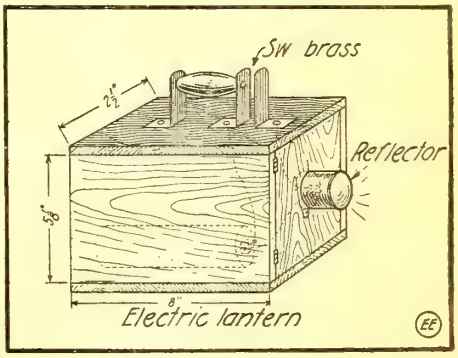


A Cheap Hand-Drill for the Experimenter Constructed from a 10-Cent Egg Beater.

small size hand-drill.

Contributed by H. KIHLSTROM.

the lamp is suppo[illegible] in a miniature porcelain socket, as usual. The switch is composed of a piece of spring brass adjacent to one end of the carrying handle, as ob-



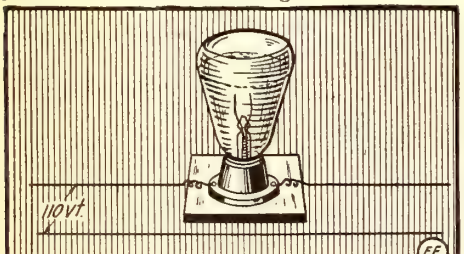
Box Type Electric Lantern Adapted for Use with Standard Dry Cells.

served in the illustration, so that the thumb can press this spring against one of the handle ends very easily and in this way close the battery circuit.

Contributed by ROBERT FORNEY.

A CHEAP CURRENT REDUCER.

Here is a description of a current reducer with which I am operating my 1-inch coil on 110 volts alternating current. I am



Cheap Current Reducer Made from Old Lamp Bulb.

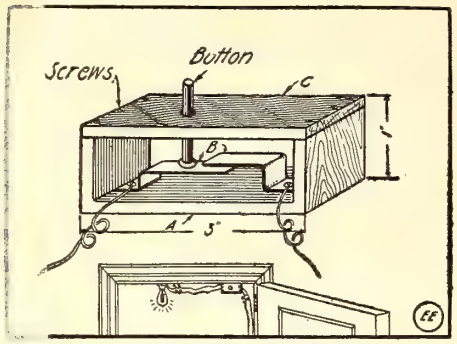
using two of them in series and they give my coil a fine pitch by stretching a rubber band across the vibrator: Take a common burned-out lamp bulb and with a glass cutter cut off the top. File the top smooth, cut off wires about 1½ inches from bottom and fill with water. If not enough current passes through, add a little common salt to the water.

Contributed by G. C. MILLER.

AUTOMATIC ELECTRIC DOOR SWITCH.

Many electrical experimenters have lighting circuits for illuminating dark closets and sometimes forget to turn off the battery when through with it, with the result that the batteries and light soon become worn out. They will probably find a ready use for this device of mine, which never "forgets," as it works automatically.

As can be seen from the drawings, when



Automatic Closet Switch Extinguishes Lamp When Door Is Closed.

the door of the closet is open (there being no pressure on the button) the brass strips come into contact, thus closing the circuit. The reverse is the case, however, when the door is closed. Thus opening and closing the door makes and breaks the circuit, respectively.

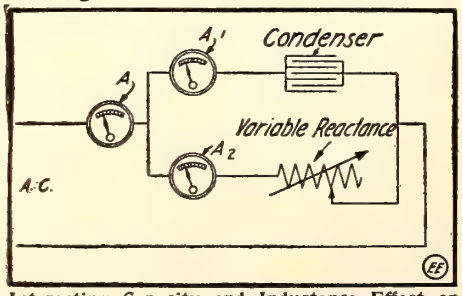
To make the switch cut or saw a piece of dry wood into the shape shown at A. Then bend and fasten on it two springy brass strips B, with two screws and nuts, which serve the double purpose of holding the strips in place and acting as binding screws for battery wires. A cross piece C, with a hole in the middle for button, is then screwed or glued into position. Care should be taken that the button connects with the under brass strip and not the upper, as this is the important feature of the device. Lower figure shows he switch screwed in position on the top jamb. If a neat appearance is desired cover with shellac or varnish.

Contributed by JOHN T. DWYER.

AN INTERESTING A.C. EXPERIMENT.

The following is a very interesting experiment in electrical phenomena, which will undoubtedly interest some of your readers, and those who are interested in wireless already have the necessary apparatus for performing this experiment at hand.

A condenser and a variable reactance are connected in multiple with ammeters A, A_1 and A_2, as shown in diagram. The reactance should be varied until ammeter A has reached its maximum reading; such a condition is called electrical resonance. It will be noted that the sum of the readings A_1 and A_2 will be very much greater than A, which is apparently contrary to the laws which govern a divided circuit, as the am-



Interesting Capacity and Inductance Effect on A. C. Circuits.

meters indicate that more current is flowing in the divided circuits than is actually entering them. The theory for the above can be found in any reputable text book on alternating currents under the head of electric resonance.

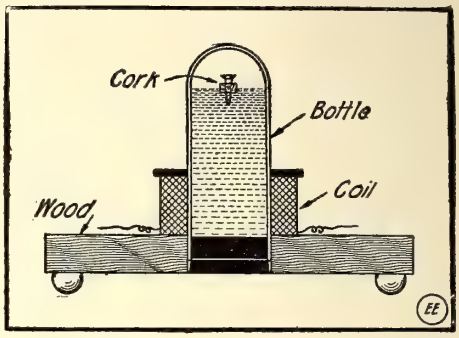
This experiment, when carefully reasoned out, should prove very amazing as well as instructive to the embryo electrician.

Contributed by H. C. YEATON.

AN EFFICIENT BATTERY TESTER.

This battery tester, although it does not tell the exact number of volts and amperes in a battery, will tell roughly the amount of energy left in it.

Procure a piece of wood 2½ inches square and ½ inch thick and put a ⅛-inch bevel on it. Then find the center of it and bore a ⅝-inch hole. Procure a small straight bottle, such as cheap colognes come in, and fasten it securely in the hole



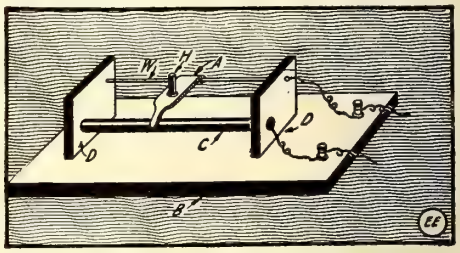
The Magnet Coil Attracts the Cork and Iron Screw, Forming a Useful Battery Gauge.

by wrapping paper around it and gluing it so that the neck of the bottle is flush with the bottom of the wood. Glue a cardboard disc in the center of the bottle and let it dry securely. Then take a ⅞-inch wire nail and a small bit of cork. File off the nail and cut the cork so that there is *just* enough cork to float the nail in water. Then measure off about 20 feet of No. 20 magnet wire and wind it between the wood and the disc of cardboard so as to form an electro-magnet. Next fill the bottle with water and after dipping the cork in shellac, seal the bottle. By putting one wire on the carbon and the other on the zinc, the cork will go down and will rise as soon as the power is shut off. The harder and faster it goes down, the more current the battery contains. On a very weak battery it will simply move on the surface.

Contributed by WILLIAM BINGHAM.

SIMPLE FORM OF RESISTANCE.

The construction of a simple form of resistance is described as follows: (See drawing) C is a length of carbon rod,

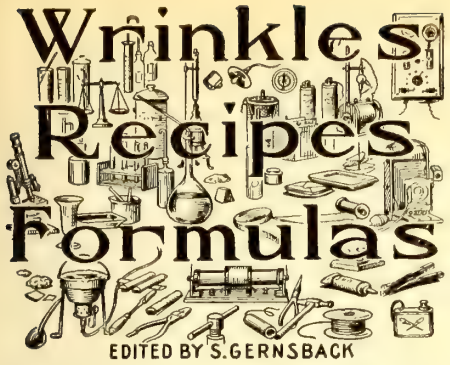


Rheostat Made from Arc Lamp Carbon and Slider.

such as used in motion picture machines. W represents a length of No. 4 copper wire. A is a piece of tapering sheet brass, bent into cylindrical form at the wide end to slide along wires W. H is a wooden knob. D are wooden blocks; B the base with terminals. By sliding A to the left or right one obtains more or less resistance respectively.

Contributed by WM. MALM.

Send us a brief description and pencil sketch of your latest stunt. We pay for them.



Under this heading we are publishing every month useful information in Mechanics, Electricity and Chemistry. We shall be pleased, of course, to have our readers send us any recipes, formulas, wrinkles, new ideas, etc., useful to the experimenter, which will be duly paid for, upon publication, if acceptable.

FORMULA NO. 20.

Extracts.

Cocoa.—Dissolve 1 lb. of *Chocolate* in 1 qt. of *Boiling Water,* let it cool, take out the *Cocoa Butter* and add to it 4 oz. of *Glycerine* and bottle.

Compound Coffee (for Dispensing).—8 oz. best (ground) *Java Coffee;* 2 drm. sliced *Vanilla Bean;* add diluted *Alcohol* in sufficient quantity.

Plain Coffee Extract.—Pour upon 1 lb. of best fresh roasted *Coffee* 1 qt. of *Cold Water,* heat gently for half an hour then let it come to a boil, cool for 2 hours, strain and add 4 oz. of *Glycerine.*

Ginger (for dispensing).—Take 1½ pt. of *Fluid Extract of Ginger,* 3 pts. of *Water,* 3 oz. of *Carbonate of Magnesia;* mix, shake often for 24 hours; filter, evaporate to ¾ pt. and add ¾ pt. of *Alcohol.*

Mead.—Oil of Lemon, 1 oz.; *Oil of Cloves,* 2 drm.; *Oil of Cinnamon,* 2 drm.; *Oil of Nutmeg,* 1 drm.; *Oil of Allspice,* 30 drops; *Oil of Sassafrass,* 40 drops; *Oil of Ginger,* 1 drm.

Cut the *Oils* with *Pumice* and *Sugar;* dissolve in 16 or 32 oz. of *Alcohol.*

Add gradually an equal quantity of *Water;* clarify.

Liebig's Meat Extract.—1 oz. *Lean Meat,* very fresh, chopped very small; add 8 oz. *Cold Water;* shake well together for 10 minutes; heat gradually to boiling, let simmer gently for a few minutes, strain through a hair sieve while still hot; evaporate to a soft substance.

Sarsaparilla Extract.—Take 16 oz. *Jamaica Sarsaparilla,* cut transversely, 280 oz. *Distilled Water* (160° F.), macerate in half the water for 6 hours and decant the liquor. Digest the residue in the remainder of the water for six hours more, mix the liquors, press and filter.

Evaporate by a water bath to 7 oz. when cold, add 1 oz. of *Rectified Spirit.*

Peach.—3 drm. *Oil of Almonds,* 3 drm *Oil of Pineapple,* 3 drm. *Tartaric Acid,* 1½ pt. of *Alcohol,* 80°.

Pineapple.—2 oz. of *Pineapple Essence,* 1 oz. of *Citric Acid,* 2 pts. of *Alcohol,* 80°.

Strawberry.—1½ oz. of *Pineapple Oil,* ¾ oz. of *Tincture of Orris,* ¾ oz. of *Tartaric Acid,* 1½ pts. of *Alcohol,* 80°.

S. G.

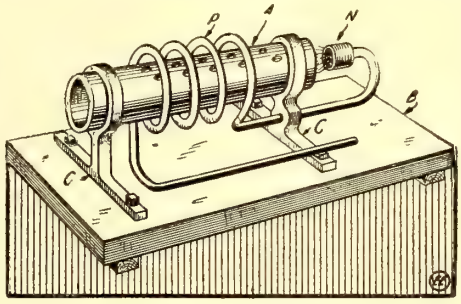
Did you ever stop to think that for every carbon lamp in your chandelier you may have three times the candlepower at the same cost for current by substituting tungsten lamps.

When you think of a new idea, write it down. Otherwise you will forget it.

A GASOLINE TORCH FOR THE EXPERIMENTER.

A very handy gasoline torch for the experimenter's laboratory can be successfully and easily built. This torch will develop a considerable amount of heat, which is frequently needed for certain experiments. The burner is made from a piece of brass tube, A, as illustrated in illustration. This should be ½ inch in diameter and 2½ inches long, plugged up at both ends, one end being drilled and reamed out to 5-16 inch. Three rows of holes 1-16 inch in diameter are next drilled in the tube as depicted. One row is drilled to come directly on top and the other two at about 45° from the vertical. It is then fitted to a sheet steel base, B, by means of the clips, C, C. A piece of ⅛-inch copper pipe, P, is next coiled around the brass tube, A, to form the vaporizing coil. This coil should have a diameter of about 1 inch. One end of the copper tube is bent around so it will point directly into the reamed out hole in the end of the brass tube, A. A nipple, N, is made by drilling a ⅛-inch hole half way through a piece of brass, topped to fit the ⅛-inch hole. A 1-64-inch hole is then drilled through the remaining part of the nipple. The other end of the copper tube is connected to the supply tank.

The distance between the nipple, N, and the end of the tube, A, should be only 5-16 inch. The supply tank can be made from a brass tube 3 inches in diameter and 6 inches long, with the ends sealed by soldering on two end pieces of the same material. A small cock is provided, which is directly connected to the torch. A small



A Home-Made Gasoline Torch.

hole is made on the top of the tank to allow air entering the interior, in order to force the gasoline to the burner. Care should be taken in handling the gasoline, as it is very inflammable. It will be found that the torch will produce a hotter flame when the copper coil is quite hot; this is due to the fact that the gasoline is more readily vaporized and consequently a better mixture is produced.

In order to start this device vaporizing it is necessary at first to warm the coil by means of a match, or with a little gasoline ignited under the worm.

Contributed by LOUIS WEISS.

CHEMICAL EXPERIMENTS.

By W. A. Talmage.

THE POPULAR WINE AND WATER TRICK.

OBTAIN a small quantity of phenolphthalein from your chemist or druggist in powder form. Dissolve it in a small bottle and keep well corked. When ready for the trick (before the performance) place some of this solution in a small crystal or porcelain pitcher and partly fill with clear water, then prepare four wine glasses or small tumblers as follows: No. 1 glass with about a teaspoonful of ammonia. No. 2 glass clear. No. 3 glass with a teaspoonful of ammonia, and No. 4 glass with two teaspoonfuls of acetic acid.

More glasses and chemicals may be used if desired, but must be prepared as above. To perform the trick pour from pitcher into glass No. 1 and we have *wine,* then into glass No. 2 we have *water,* and glass No. 3 we have *wine,* then glass No. 4 we have *water;* pour back glasses 1, 2 and 3 into pitcher and then fill the three glasses with *wine* from the pitcher, now pour all four glasses back and then fill them with *water* from the pitcher.

A little practise before you attempt this with your friends will enable you to handle glasses and pitcher skilfully. Try to cover the solution in glass No. 4 with your hand when pouring into it for the first time.

CHEMICAL COLOR CHANGES.

The following chemicals should be dissolved separately in individual bottles, labeled properly and kept tightly corked:

No. 1—Permanganate of potash, ½ dram; water, 4 ounces.

No. 2—Caustic soda or potash, 1 dram; water 4 ounces.

No. 3—Hyposulphite of soda (hypo), 2 drams; water, 4 ounces.

No. 4—Bichloride of mercury (poison), ½ dram; water, 2 ounces.

(Be sure and label bottle *poison.*)

No. 5—Sulphate of iron, ½ ounce; water, 4 ounces.

No. 6—Red prussiate potash, ½ dram; water, 2 ounces.

No. 7—Oil of tartar, this is made as follows: Carbonate of soda or common washing soda, ½ ounce; water, 4 ounces.

No. 8—Acetic acid (clear acid).

The above chemicals are all used in photography and may be purchased of any photo dealer.

In a tumbler containing a small quantity of water place enough No. 1 solution to give a nice wine color, then add about a half teaspoonful of No. 2 solution, this will slightly redden the No. 1 solution; now place a few drops of No. 3 solution, this will change to green; add a small quantity of No. 8, you will observe this to turn brown and then clear itself. Rinse tumbler out thoroughly.

Put about ten drops of No. 4 in half tumbler water, add a small quantity of No. 7, this changes to a deep orange color; now add a small quantity of No. 8, immediately clears itself. Remember that No. 4 is *poison* and should be handled with extreme care. Rinse glass thoroughly.

A small quantity of No. 5 in a half tumbler of water will be a clear solution and a small quantity of No. 6 in half tumbler of water will be clear; add both together and you will have a deep navy blue.

By further experimenting with above chemicals you will be able to perform many other changes.

MYSTERIOUS SMOKE TRICK.

Place a small quantity of ammonia in a tumbler and upon a small piece of clear glass place a few drops of muriatic acid. Tell one of your friends that you can find out whether he is an excessive smoker or not, and have him place his thumb on the under side of the sheet glass and carefully turn it over on top of the tumbler with his thumb still in position; the result will be an excessive amount of smoke issuing apparently from his thumb.

MYSTERIOUS FIRE.

A small quantity of chlorate of potash mixed with the same amount of sugar placed on a piece of tin or stone and then touched with a stick dipped in sulphuric acid will instantly burst into a bright white flame. If a small quantity of strontium nitrate is mixed with this the flame will be red instead of white, or if the same amount of barium nitrate is mixed instead of strontium the flame will be green.

WITH THE AMATEURS

Our Amateur Radio Station Contest is open to all readers, whether subscribers or not. The photos are judged for best arrangement and efficiency of the apparatus. To increase the interest of this department we make it a rule not to publish photos of stations unaccompanied by that of the owner. Dark photos preferred to light toned ones. We pay each month $3.00 prize for the best photo. Make your description brief. Address the Editor.

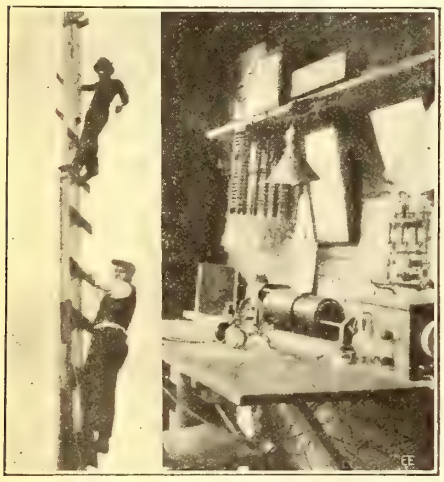
AMATEUR RADIO STATION CONTEST.

Monthly Prize, $3.00.

This month's prize winner.

C. HERSCHEL WOODRUFF'S RADIO STATION.

A short time ago a ½-K. W. "Hytone Set" was left in my care with permission to use it on my aerial. I tried a little experiment which cleared up the trouble. This is the method to follow: First, take a piece of lamp cord, which is made of a number of small wires, and ground the earth side of the oscillation transformer. Then make a small gap of about ½ inch, using one strand of the lamp cord as one electrode. At first you may get a heavy, thick spark when the key is pressed, which



Lower Figure on Mast Is C. H. Woodruff, Owner of Station Shown at Right.

would not melt the wire, but by changing the tuning you will be able to get a spark which will melt a No. 10 copper wire.

With this arrangement I was able to "raise" a dozen amateurs. The range covered Cincinnati, St. Marys, Lima, Tiffin, Mt. Gilead, Mt. Vernon, Springfield and Fort Wayne, Ind. (9.P.C.).

The aerial was 90 feet long, 4 wires spaced 2 feet apart, 65 feet high. In the picture of my mast, the lower figure is myself, while the one above is a friend of mine (8.T.T.). The transmitter is ¼ K. W. with oil condenser, rotary gap and oscillation transformer. The gap is enclosed in a box just above the oscillation transformer.

The receiving set is of my own construction, as is the transmitter, and consists of 4,000 meter loose coupler, audion detector and 'phones. My set is capable of sending 40 miles and covers from 25 to 35 miles regularly. The receiving outfit has a range which covers Tampa, Fla., Miami, Fla., Key West, Galveston, Texas and Port Arthur.

C. HERSCHEL WOODRUFF.

Columbus, O.

HAROLD BENNETT'S RADIO STATION.

Herewith I present a description and photograph of my wireless station for competition in your Amateur Wireless Station



Wireless Station of Harold Bennett.

contest. All of my instruments were purchased and mounted in cabinets. On the left of the illustration will be observed the receiving set, which is composed of an Arlington type D transformer, and detector (on top of cabinet). On the side of the case is a loading coil, variable fixed condenser and receiver block. My receivers are 2,000-ohm type of the Murdock make. The sending set consists of a spark coil used in connection with a separate interrupter and condenser. On top of the cabinet is a spark gap and a large helix.

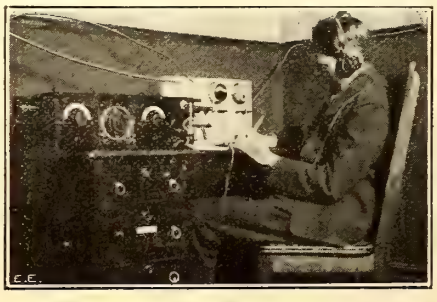
I can transmit 13 miles and receive 1,500 miles, hearing Arlington and several other high-power stations. I would be glad to hear from any amateurs, or exchange photographs of my set with them.

Clarinda, Ia. HAROLD BENNETT.

LONG DISTANCE RADIO STATION OF C. L. TODD.

Herewith is a photograph of my radio station, the description of which is as follows: The transmitter consists of a "Blitzen" ½-K. W. transformer with Clapp-Eastham condenser, Murdock rotary gap and a "jigger" (oscillation transformer). Sending range approximately 300 miles. QRK at 2CE and QSA at 8LQ. Marble switchboard contains meters and antenna switch.

The receptor is mounted in and on a mahogany cabinet fitted with hard rubber



Conway L. Todd Receiving Radio Messages.

face. The instruments contained thereon are: Two Clapp-Eastham "Cambridge" variable condensers, their type "D" tuner, De Forest audion and loading inductances controlled by telephone cam switches. Receiving range about 2,500 miles.

The antenna is triangular, 30 feet on a side, constructed of stranded phosphor-bronze wire No. 10. It is 50 feet in height and very well insulated.

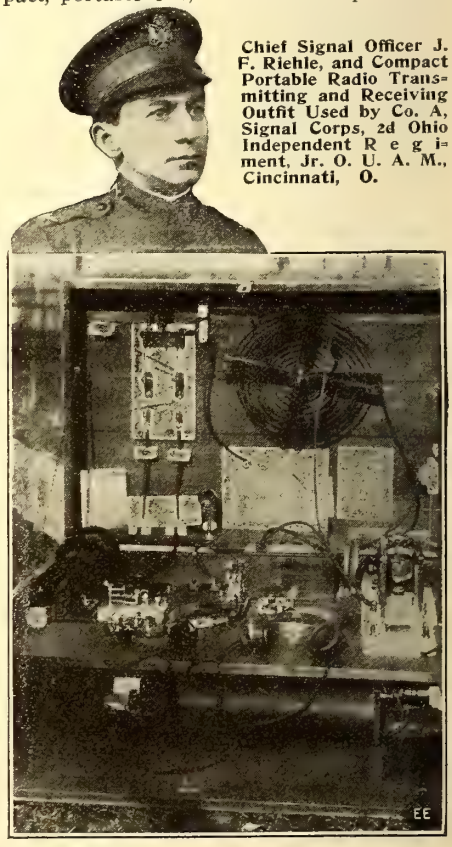
I would be glad to hear from any amateur within range. Working hours from 7 to 11 p. m. Call 8 A. D. E.

CONWAY L. TODD.

Rochester, N. Y.

PORTABLE WIRELESS SET OF J. F. RIEHLE.

The radio set here depicted is a compact, portable one, which can be placed on



Chief Signal Officer J. F. Riehle, and Compact Portable Radio Transmitting and Receiving Outfit Used by Co. A, Signal Corps, 2d Ohio Independent Regiment, Jr. O. U. A. M., Cincinnati, O.

the back of a Ford runabout. It consists of a ½-K. W. 110-volt transformer, a 1-inch spark coil, a rotary and stationary spark gap mounted on marble, 5 moulded condensers for sending, 2 detectors, 2 variable condensers, 1 for primary and 1 for secondary of loose coupler, a large loading coil, fixed condenser and 2 1,000-ohm 'phones, also a large oscillation transformer, aerial switch and 2 sending keys, 1 for alternating current and 1 for spark coil on battery. The set can be used on either 110-volt 60-cycle alternating current or 6-volt storage battery, only two connections having to be changed to shift from one to the other. The spark gap can also be converted from rotary to stationary by two changes in the posts of gap.

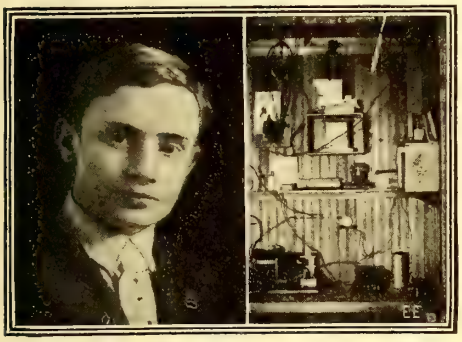
This outfit was used by Co. A, Signal

Corps of the 2d Ohio Independent Regiment Jr. O. U. A. M. (Incorporated) at Coney Island during a sham battle. The time required for setting up the collapsible poles, running the aerial and putting the entire set into operation was but 5 minutes. The poles are 50 feet high and the aerial is composed of No. 10 copper wires, each 85 feet long. I have been able to receive all of the coast stations, including Key West, but am not quite sure about the sending range, but I should think it would be somewhere around 100 miles. I am the chief signal officer of the Signal Corps, also an electrical inspector with the Cincinnati Fire Prevention Bureau, and therefore keep in touch with nearly all the amateur operators in my vicinity. J. F. RIEHLE.

Cincinnati, O.

ROBERT WITSCHEN'S WIRELESS OUTFIT.

Herewith I am submitting a photograph



Master Robert Witschen and His Neat Radio Station.

and description of my station. Not all of the apparatus that I own can be seen in this illustration. On the left you will observe my receiving outfit, which comprises a loose coupler, fixed condenser, 1,000 ohm single head-set and a Crystaloi detector. The sending outfit consists of a ½-inch coil, a home-made spark gap and a fixed condenser. The aerial has five wires on nine-foot spreaders and is 48 feet long and 48 feet high.

I should like to get acquainted with other amateurs within 60 miles of my station. My age is 15 years.

ROBERT WITSCHEN.

St. Cloud, Minn.

WEATHER FORECASTS BY WIRELESS.

A new scheme about to be inaugurated by the Weather Bureau will be the sending of weather reports to farmers by wireless. This experiment is to be tried out in Illinois and, if successful, the system will be spread to other States which request it. The messages will be transmitted at the rate of 10 or 12 words a minute to accommodate amateur operators who are not usually proficient enough to receive faster. An approved card has been provided whereon the receiving wireless operator copies the forecast message and posts it for the benefit of the public. Any farmer with an inexpensive receiving apparatus and a knowledge of the Morse code can obtain these forecasts by "listening in" while the station is sending them out.

RADIO STATION OF K. KERMET KRAMER.

The accompanying illustration is of my wireless station. The aerial is 32 feet high at one end and 40 feet at the other, and is composed of two copper wires 100 feet long. The receiving set consists of an Amco loose coupler, home-made loading



K. K. Kramer and His Effective Experimental Wireless Set. Sending Range 2 to 3 Miles. Hears N. A. A. and N. A .M. at Elizabeth City, N. C.

coil, Brandes' 2,000 ohm 'phones, Crystaloi detector, fixed and variable condensers and a buzzer test. The transmitting set is mounted in and on a mahogany finished box. It consists of a Mesco helix and key, spark gap, Leyden jar and auto spark coil. I can receive N. A. A., N. A. M. and many other stations very loud and clear. The sending set has a range of about two to three miles. K. KERMET KRAMER.

Elizabeth City, N. C.

Wireless equipment and a heliograph have been combined by a New York inventor in portable signaling apparatus for use on railroads or at sea.

Amateur News

Radio Club of America.

The December meeting of the Radio Club of America was held on Saturday evening, Dec. 4, in Fayerweather Hall, Columbia University.

L. J. Lesh, of the Aero Club of America, presented a paper on "The Development of Radio Sets for Aeroplanes." Mr. Lesh is the foremost worker in this field of radio work. The paper was plentifully illustrated by lantern slides of the recent tests conducted by Mr. Lesh and Emil J. Simon at the Curtis laboratories at Hammondsport, N. Y. Results of many interesting experiments with the "aerofan" were discussed.

The discussion following the paper was participated in by Fritz Lowenstein, E. J. Simon, L. G. Pacent, Paul F. Godley, Walter S. Lemmon and Ernest Amy.

The Cape May County Radio Association.

The Cape May County Radio Association, of Wildwood, N. J., which was organized in May, 1915, would like to hear from other clubs and amateurs within a radius of 100 miles.

The officers are: Edwin L. Chalmers, president; Edward N. E. Schlichting, secretary; Richard J. Anderson, treasurer.

All of the officers are licensed and have up-to-date sets.

Bradentown, Fla., Radio Club.

The amateurs of Bradentown, Fla., have organized under the name of the Bradentown Radio Club, with ten members at present. Meetings are held weekly in a small building which has been converted into a club room. The club has purchased a receiving set and intends to add sending apparatus as soon as possible. The club is anxious to get in touch with other amateurs or clubs in the State through its secretary, Hughson Hurlebaus, 439 Main street, Bradentown, Fla.

Amateur Radio Association of New Bedford, Mass.

The first meeting of the Amateur Radio Association of New Bedford, Mass., which was held at Mr. H. Johnson's station on Oct. 27, at 240 Chancery St., was a great success. The officers, elected for a term of three months, were as follows: President, Antone Sylvia; Financial Secretary, Horace Johnson; Station Inspector, Ralph E. Taylor. A committee was appointed to draw up a constitution for the association. The object of the association among amateurs is to develop a more extensive knowledge of wireless telegraphy. The members who attended the first meeting were Antone Sylvia, Horace Johnson, Henry Ackerman, Ralph E. Taylor, Frank Allen, William Pinnington, John W. Callaghan, Douglas Tripp, Stanley Wood and Anthony Hayden.

New Radio Club Organized at Rockaway Beach, N. Y.

Local amateurs have succeeded at last in organizing a radio club called the "Rockaway Radio Club" for the purpose of bringing together the many amateurs in this vicinity. Two successful and interesting meetings have been held in the club rooms at No. 296 Washington Ave., Rockaway Beach, L. I., the second of which resulted in a decided increase in membership. The following officers were elected: President, H. Conway; Vice-President, R. Richter; Treasurer, J. V. Byrue; Recording Secretary, Lewis Wagerer; Corresponding Secretary, H. Friegerlin; Sergeant-at-Arms, L. Anderson.

For the convenience of the members a library has been established and E. Richter and W. Byrue were appointed librarians to take charge of same. Address all communications to Rockaway Radio Club, 296 Washington Ave., Rockaway Beach, N. Y.

Election of Officers of the Arlington Radio Club.

At a recent meeting of the Arlington Radio Club of Arlington High School (Mass.), the following officers were elected: W. C. Clark, president; Eliott Perkins, vice-president; Harold O. Bixby, secretary and treasurer. The club has a large membership and will soon have both efficient transmitting and receiving sets in operation.

RADIO CLUBS ATTENTION!

We are always pleased to hear from young Edisons and Radio Clubs. Send a write-up of your Club with photos of members and apparatus to-day to: Editor "Amateur Gossip" Section, The Electrical Experimenter, 233 Fulton St., New York City.

New Radio Club in Akron, Ohio.

The Akron Radio Club, of Akron, Ohio, was recently organized and the following officers were elected: Jack Gritton, president; Donald Hoffman, vice-president; Clarence W. Brown, secretary; Virgil Baysinger, treasurer; Darley Thurmes, exchange manager; Roland Palmer, electrician, and Howard Myers, inspector. The club has twenty-two members at present. Meetings are held weekly at the president's home. The club members would like to communicate with other radio clubs. Address all communications to Clarence W. Brown, R. F. D. No. 25, Akron, Ohio.

Association at Pensacola, Fla.

There was organized in Pensacola, Fla., on the first of January, 1916, a radio association which will be for the benefit of the amateurs of United States and Canada. It will be operated on a new basis which will be more of a help to the amateur and laymen than any other association in the country.

All amateurs interested in this movement please write for full information to T. H. Moore, Jr., 321 North Spring street, Pensacola, Fla.

The Carrollton Radio Inter-Communication Club.

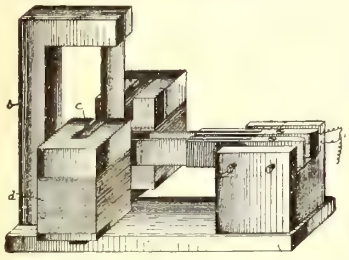
The Carrollton Wireless Club was reorganized in the laboratory of the public school at Carrollton, Ill., Nov. 24, as the Carrollton Radio Intercommunication Club. The following officers were elected: Ward Dickson, president; David Roberts, vice-president; Stuart W. Pierson, secretary and chief operator; Owen Jarboe, treasurer. The purpose of the organization is to regulate the radio work in Carrollton, to make the members proficient operators and to study the art of radio communication. The club will meet every other Tuesday. At each meeting papers pertaining to some special topic are read and then discussed. The secretary would like to hear from any one wishing to get in communication with Carrollton, Ill.

LATEST PATENTS

Resonating Relay.

(No. 1,166,951; issued to Hans von Kramer and Gilbert Kapp.)

This device involves valuable factors controlling the movement of contacting or circuit-closing vanes.

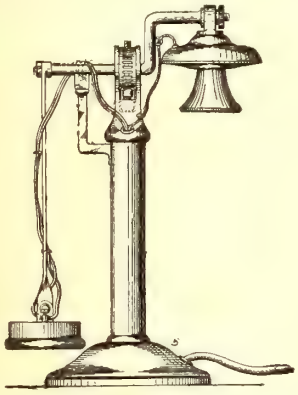


These factors may be varied in different ways and a relay can be tuned to respond to any desired frequency within certain limits. This device is capable of being operated by very feeble alternating currents and when so acuated can close the circuit in the usual manner. The magnetic circuit is permanently magnetized.

Telephone Attachment.

(No. 1,163,326; issued to David Y. Donaldson.)

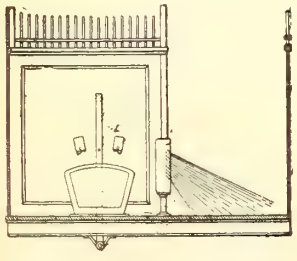
An improved form of telephone desk set whereby the transmitter and receiver are mounted on a revolving arm. Normally the transmitter and receiver hang downward so as to be dust and germ proof. The receiver is also mounted on a rigid arm, so as to be held in the proper position when the apparatus is revolved for talking, thus doing away with the task of holding the receiver to the ear.



An Elevator Door Light.

(No. 1,164,301; issued to Charles E. Moore, asignor to Elevator Supply & Repair Co.)

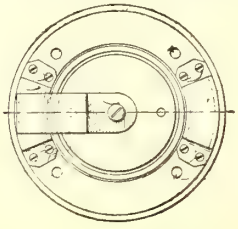
A threshold illuminator for elevators, etc., whereby the floor at the opening of the doorway is lighted to prevent persons from tripping. Whenever the car stops, the lamps, which are arranged in a special reflector as observed, are switched on automatically and off again as the car proceeds on its journey. This arrangement is now in use in some of the largest office buildings where it has proved invaluable in the prevention of accidents.

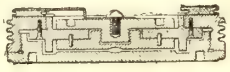


Quenched Spark Gap.

(No. 1,163,568; issued to Frederick G. Simpson.)

This patent relates to the design of quenched spark gap units intended to be interchangeable and comprises a special insulation ring into which are threaded the metal sparking surfaces of substantial size. The gap is thus particularly rugged. Again the various parts are made of materials having nearly the same coefficient of expansion, so that no variation of the spark gap length can occur due to heating of same.

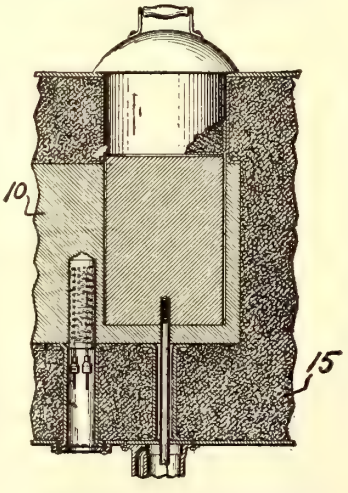




Electric Heat-Storage System.

(No. 1,161,748; issued to William Stanley, assignor to General Electric Company.)

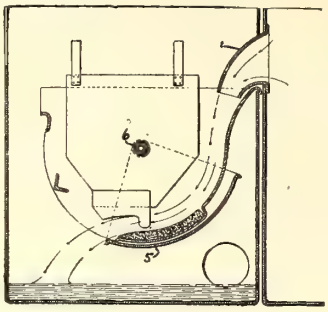
This invention relates to an improved method of storing heat electrically and pertains especially to the arrangement and selection of the heat absorbing materials. A metal container 10, is placed in a quantity of heat storing material 15 (electric furnace sublimation products containing silicon, for instance). Means are provided in the design suggested, whereby the heat developed is automatically regulated according to the temperature of the heat storage materials, as by using iron wire in the electric resistor.



A Liquid Rheostat.

(No. 1,161,746; issued to George Squire, assignor to General Electric Co.)

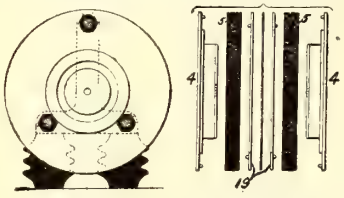
The inventor of this rheostat of the liquid type, endeavors to improve the efficiency of the same, especially as to the proper cooling of the fixed electrodes. A liquid is introduced through an upper nozzle 1, the discharging orifice of which may be changed as desired by swinging the segmental apron 5, upward on its axis 6. In this manner the liquid carrying current is constantly flowing past the fixed electrodes and has but little chance to heat, besides cooling the tips of these electrodes in a very efficient manner.



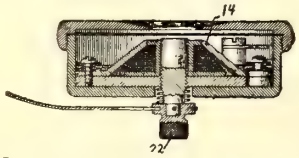
Quenched Spark Cap.

(No. 1,161,520; issued to Richard Pfund.)

A quenched spark gap improvement intended to do away with the thin and delicate insulating washers now in vogue. In this design a heavy insulating washer 5 is used, also two metal plates 19, and between these are placed a metal spacing washer 7. Cooling vanes of metal are placed between every gap or against plates 4 and 4, for instance. It will be seen that this design offers many advantages over that ordinarily in use nowadays.



Telephone Receiver.



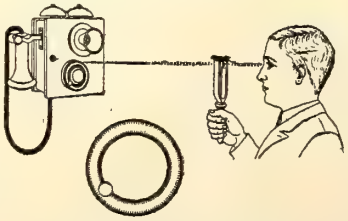
(No. 1,166,152; issued to Thomas Rhodus, assignor to The Magniphone Co.)

This is an improvement on the electromagnetic type of telephone receiver, designed so that the magnet coil will occupy the minimum amount of space and thus provide as large a (sound) resonance chamber within the receiver as possible. The yoke of the electro-magnet is in the shape of an iron cone 14. The center core may have its air gap before the diaphragm varied by means of an adjusting nut 22. The spiral spring under the nut takes up any lost motion in the core thread.

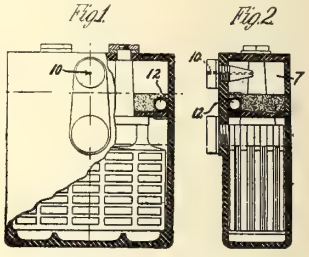
Telephone Synchronizing Device.

(No. 1,160,356; issued to Arthur H. Adams, assignor to Western Electric Company.)

This device is intended for the purpose of simplifying the synchronization of automatic telephone calling discs The disc itself, or a paper template fitting over same, is provided with two circles composed of black points. When these are viewed through the tuning fork synchronoscope as perceived, they appear to be stationary if the speed of the disc is correct.



It will be obvious that for the tuning fork shown and described herein there may be substituted any other device by which a slit opening could be presented before the observer with a frequency as in the case assumed, for example, of 110 per second. It will also be obvious that the invention may be adapted to any desired maximum or minimum speeds of rotation, and that the number of projections stamped or printed upon the card or disc may be changed either with or without a corresponding change in the periodicity of the tuning fork or equivalent device.





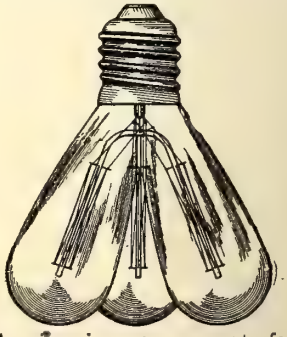
Storage Battery Vent.

(No. 1,160,491; issued to Phelps Brown.)

Ingenious device for venting storage batteries of the acid type. A splash chamber 7, is provided with a peculiarly shaped tube 12, joining this chamber with the one below containing the plates of the cell. In this fashion gas may pass up into the splash chamber and out through the perforated plug 10. Any acid splashing into the upper chamber will readily pass back through the tube 12, and it is claimed that when properly designed that no capillary leakage of the electrolyte can take place.

Electric Cluster Light.

(No. 1,169,346; issued to Thomas O'Donnell.)



An ingenious arrangement for combining several electric lamp bulbs into a common unit, as perceived from illustration. A very good idea for lamps which are to be used in public places, etc., and capable of giving a more even distribution of the intrinsic brilliancy than when one bulb is used with a concentrated filament of equivalent candlepower. A standard Edison screw base may be used for this cluster lamp. The filaments may be connected on multiple or in series as the manufacturer may elect.

COPIES OF ANY OF THE ABOVE PATENTS SUPPLIED AT 10c. EACH.

Phoney Patents

Under this heading are published electrical or mechanical ideas which our clever inventors, for reasons best known to themselves, have as yet not patented. We furthermore call attention to our celebrated Phoney Patent Offizz for the relief of all suffering daffy inventors in this country as well as for the entire universe.

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PHONEY PATENT OFFIZZ

No. 1492 / 23° S.W.

Patent Applicated September Morn, 1813

AN ELECTRO-MECHANICAL BREATHMOTOR

To whom it may confound:

Be it known that I, O. Bedamed, a denizen of Luny Park and a resident of the local Institution, second floor, padded cell number 4, have invented a new and useful Improved Means for generating current, of which the following is a full, intoxicated execution.

This invention relates to a means for utilizing the heretofore wasted energy generated by mankind, and has for an object the production of electric power.

Another object is the utilization of waste muscular energy. (The word waste has no reference to Her waiste.)

This invention converts the perpendicular movement of chest and stomach by means of levers, ratchet wheel, belt, and dynamo, into electrical energy, which said energy may be disposed of in various ways, such as heating a Chicken incubator, or operating an automatic spanker for conserving the skin on the palm of Father's hand.

The action of the apparatus is as follows: The victim retires (this does not have reference to a Ford owner) and assumes a horizontal position with the stomach uppermost. The petitioner assumes that the operator is a man, for said petitioner has no knowledge of the anatomy of the gentler sex, and cannot affirm his belief to the presence of said stomach in said sex. Said petitioner has been informed, however, that the gentle cow has six stomachs.

When said position is assumed the stomach is in position to do overtime work, and for every inhalation and exhalation there will be a movement of attachment 1 (which is erected to conform with the natural formation of the protruberance) and a corresponding movement of the rod 2 and the lever 3, which moves on axis 4; the end of the lever 3 has attached thereon a pawl which engages with the ratchet wheels and produces a circulatory movement to the balance wheel, 6, and to the shaft on which said wheel is attached. This motion is transmigrated to the dynamo, 7. If the speed is too slow, a governor, 8, connects a current to the victim, and causes his respiratory action to increase surprisingly.

What I claim is:—

1. A breathmotor which will utilize the energy wasted by bums, loafers, and tinhorn sports who wear checkered clothes and put their thumbs in their suspenders. This arrangement will be a boon to women who have said bums, as they can run a washing machine, butter churn, wood saw or ensilage cutter by electricity.

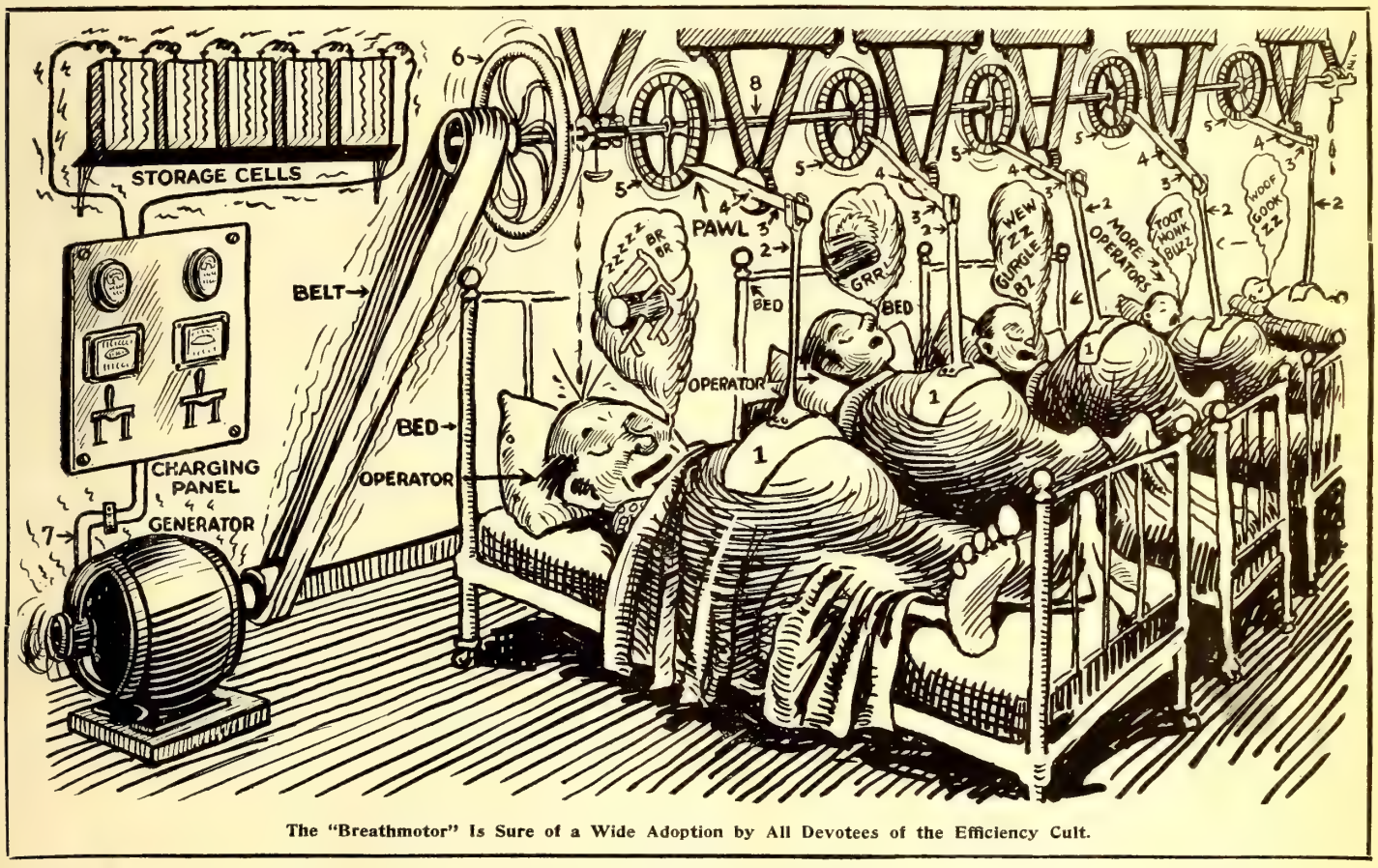
4. A breathmotor by which energy can be collected in such places as Hotel De Gink, Hoboes' Heavenly Home, Weary Willie's Wresting Palace, and Trusting Tramps' Tryst.

19. A breathmotor which will earn 1,765 per cent. on investments in free lodging houses by generating, without cost, sufficient current to light Broadway, Chinatown and Sing Sing.

In testimony whereof, I firmly fix four former friends' fingerprints in the presents of these two tired and totally trustworthy allies, and witnessed this 30th morning of Februember, 1812.

(Signed) O. BEDAMED,
By his attorney,
F. S. Schlink.

Witnesses: I. M. Busted, Gosh A. Mity, Hoop S. Mydeer.

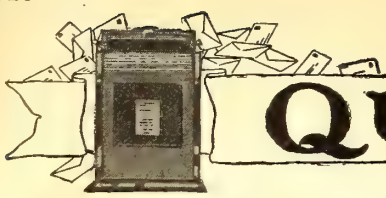


The "Breathmotor" Is Sure of a Wide Adoption by All Devotees of the Efficiency Cult.

BUZZER AWOKE HIM TO SPY ON SPOUSE.

Electrical dealers in Washington, D. C., are making the most of the published announcements of a recent divorce suit in that city. The case is that of Mrs. Emma S. Bullis against Dr. M. C. Bullis.

In his cross-bill the doctor told how he kept track of his wife's movements during the night, although she slept in an adjoining room. He attached two small wires to the door of her room, connecting them through an electric battery to a small buzzer on a cord, which he wore around his neck. The moment his wife's door opened or closed he was awakened and was on the *qui vive.*



QUESTION BOX

This department is for the sole benefit of the electrical experimenter. Questions will be answered here for the benefit of all, but only matter of sufficient interest will be published. Rules under which questions will be answered:

1. Only three questions can be submitted to be answered.
2. Only one side of sheet to be written on; matter must be typewritten or else written in ink, no penciled matter considered.
3. Sketches, diagrams, etc., must be on separate sheets. Questions addressed to this department cannot be answered by mail.

COMPOUND WOUND DYNAMO.

(471.) L. A. Madison, Kingman, Me., wishes to know: 1. What is the largest motor he can run on the current from a 125-volt, 44-ampere dynamo. 2. Whether it is possible to operate a compound wound dynamo in the reverse direction and obtain current from same. 3. The receiving range he would have using an aerial 100 feet long and 75 feet high, with a galena detector, tuning coil, variable condenser and 2,000 ohm 'phones.

A. 1. The largest motor that you can run with this dynamo is about 7 h.p.

A. 2. A compound wound dynamo can be run in the reverse direction providing the windings of the series field and armature are changed, or the shunt field winding may be reversed.

A. 3. The distance which you can receive with the apparatus mentioned would be between 900 and 1,200 miles. This distance would be increased under favorable atmospheric conditions.

HIGH FREQUENCY COIL.

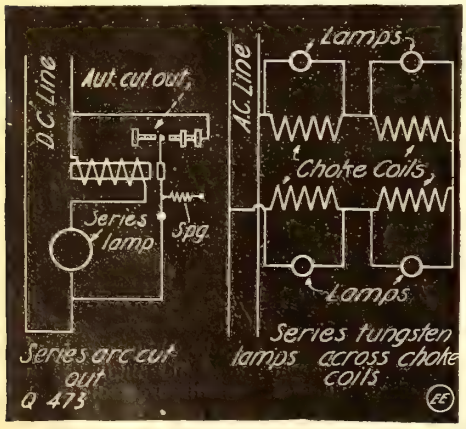
(472.) John A. McGuire, Ridgewood, N. J., asks: 1. Whether the high frequency outfit described in the November, 1915, issue of *The Electrical Experimenter* can be operated on spark coils. 2. Whether a 2-inch coil would operate this outfit.

A. 1. The high frequency outfit you mention will work on a 6-inch spark coil.

A. 2. It will not work efficiently on as small a coil as a 2-inch one.

STREET ARC LIGHTS.

(473.) Claude Martin, Brownwood, Tex., desires to know: 1. How street arc lights are connected in series so that when one burns out it does not affect the other lamps; also how this works out in series tungsten lighting schemes. 2. Why he was not able to charge a one pint Leyden jar



Automatic Cut-outs Used in Series Lighting Systems.

with a ½-inch spark coil. 3. Whether the Standard Electrical Dictionary by Prof. O'Connor Slone is self-pronouncing.

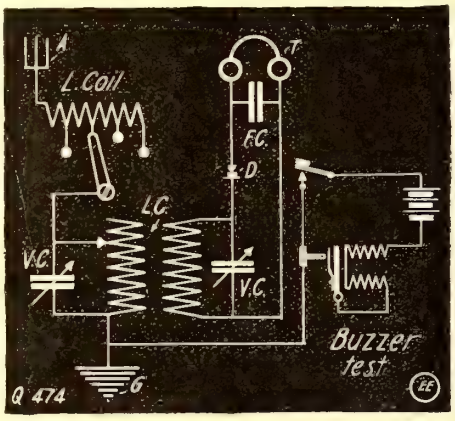
A. 1. This system is so arranged that a cut-out properly connected to each lamp, automatically operates a switch which will keep the other lamps still burning when one lamp burns out. The diagram herewith shows how this cut-out is connected.

A. 2. The reasons for not being able to charge the Leyden jar with a ½-inch coil is perhaps due to the fact that the jar was punctured, thus allowing the spark to pass through the dielectric.

A. 3. The dictionary is not a self-pronouncing one. We believe that it is impossible to obtain such a dictionary.

SLATE SWITCHBOARD.

(474.) Albert R. Saunders, New York City, wishes us to give: 1. The connec-



Radio Receiving Hook-up with Buzzer Test.

tions for loose coupler, duplex loading coils (four of different capacities), two variable condensers, fixed condenser, galena detector with buzzer test and 'phones. 2. What size wire and how much in each loading coil of the following dimensions: 1,000 meters, 1,400 meters, 2,000 meters, 2,500 meters. 3. How slate can be cut and drilled for a switchboard.

A. 1. The accompanying illustration gives the connections you desire.

A. 2. The following is the size and quantity of wire required for the various loading coils: For 1,000 meters, 330 feet; 1,400 meters, 450 feet; 2,000 meters, 660 feet; 2,500 meters, 850 feet, all No. 24 S. C. C. magnet wire.

A. 3. Slate is usually cut with a hack saw and drilled with twist drills, applying water to the drill in order to soften the slate.

THE FOURTH DIMENSION.

(475.) Morris K. Jessup, Rockville, Ind., desires us to tell him: 1. How to make a selenium cell. 2. Where he can find a book on the "fourth dimension."

A. 1. Selenium cells are usually made by winding two separate wires on an insulating material, such as mica, and applying a very thin coat of metallic selenium over same. After the metallic selenium has been applied the cell is carefully annealed. This process of annealing is accomplished by placing the cell for two to three hours in an oven and keeping the temperature just a few degrees below the melting point of the selenium. It is then allowed to cool gradually.

Our August, 1914, issue contained an excellent method of making selenium cells.

A. 2. The best book on this subject, "A Primer of Higher Space" (the fourth dimension), is supplied by us at $1.25 prepaid.

VARIOMETER.

(476.) Lloyd Bossirman, Pleasanton, Kan., wishes us to tell him: 1. The size and amount of wire necessary for building a variometer. 2. The wave length obtained by the use of above mentioned variometer and a loss coupler, the primary of which is 9x5¼ inches, with an antenna of two wires 500 feet long and a 50-foot lead-in. 3. The time that Fort Riley and Fort Leavenworth, Kan., and St. Louis, Mo., operate.

A. 1. The size of wire necessary for building the variometer would be No. 18 S. C. C. magnet wire, and the amount would depend upon the size of the coil. We think that about 50 feet of this wire would be required for winding the two coils.

A. 2. The wave length obtained with the above-mentioned instruments and the specified antenna would be about 5,000 meters.

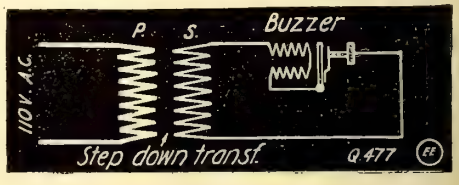
3. These stations do not have any particular time for operating.

WAVE LENGTH.

(477.) Bernard J. Bisciotti, Philadelphia, Pa., desires to know: 1. The wave length of his antenna, which is 44 feet long and 40 feet high, composed of four wires with a lead-in 10 feet long and a 6-foot ground connection. 2. Whether it is necessary for him to notify the Radio League of America when he installs a transmitting set? 3. How to hook up a buzzer to be operated on a 110 volt, alternating current line?

A. 1. The approximate wave length of your antenna is 150 meters.

A. 2. It will be necessary for you to no-



Operating Buzzer on Low Voltage A. C.

tify the Radio League of America whenever you install your transmitting set.

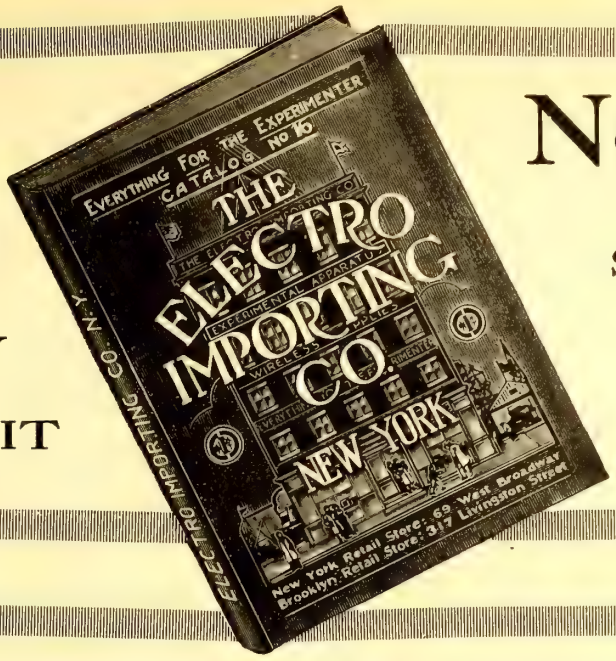
A. 3. The illustration herewith shows the connections for the buzzer which is to be operated on a 110-volt, alternating current line, utilizing a step-down transformer.

KICK-BACK PREVENTER.

(478.) Herbert T. Hintgen, Wahpeton, N. Dak., asks: 1. About some trouble with his electrolytic interrupter. 2. The approximate resistance of the carbons of dry cells.

(*Continued on page* 722.)

CAT. No. 16



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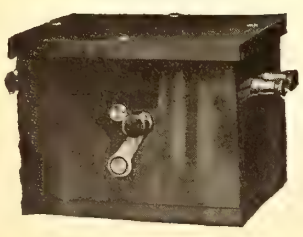
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Two Step Multi-Audi-Fone, without Head Set, $60; with Head Set, $65. Un-Damped-Waver, according to wave length, $60 and $100. Telephone Voice Multiplier for weak lines and poor ears, $15. Detectorphones for Detectives, County Attorneys, Hotels and Manufacturers, $35.

Deaf-Man's-Ear is for you, if you are deaf and want to hear, $35. Send for circular to-day and don't fail to name which instrument.

MULTI-AUDI-FONE, 275 Morris Ave., Elizabeth, N. J.

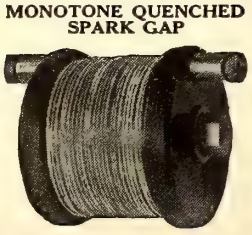
AUDIO-ROTOR



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MONOTONE QUENCHED SPARK GAP



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Quiet in Operation, Arcless, Penetrating

Already used by hundreds of operators. Only one unit required for spark coils. Transformers require two units for every ¼ KW Power. *Per unit $1.50, prepaid.*

RICHARDSON COMPANY, Commerce Bldg., ERIE, PA.

QUESTION BOX.

(*Continued from page 720.*)

3. Whether the kick-back preventer described in the February, 1916, issue of this magazine would be sufficient for the operation of a 1-kilowatt radio transformer?

A. 1. The chemicals in the construction of your electrolytic interrupter are not the right kind, and therefore you have not obtained the satisfactory results. You should use a dilute solution of sulphuric acid composed of one part of the acid to five parts of water.

A. 2. The approximate resistance of the carbons of dry cells is 1/10 to 1/5 ohm.

A. 3. The kick-back preventer described in the February issue can be used with a 1-kilowatt transformer, but we would advise you to obtain a larger one for best results.

10,000 METER LOOSE COUPLER.

(479.) Joseph Frick, Chicago, Ill., wishes us to give him: 1. Details for constructing a 10,000-meter wave length loose coupler and size and kind of wire used. 2. Information regarding the possibility of receiving Lake Bluff, with the use of a tikker in the circuit.

A. 1. A loose coupler having a wave length range of 10,000 meters can be built as follows: The primary of coupler should be 18 inches long and 6 inches in diameter, while the secondary should have a length of 17 inches and diameter of 5 inches. The primary should be wound full of No. 22 copper enamel magnet wire and the secondary with No. 24 copper enamel magnet wire. The taps should be taken out on the primary at every 30 turns and likewise with the secondary.

A. 2. With the aforedescribed loose coupler you should have no trouble in receiving Lake Bluff station with a tikker connected in circuit.

ARC EFFECTS.

(480.) Kenneth Preston, Ashland, O., inquires: 1. How he can eliminate the noises developed by an electric arc, which is located near his station? 2. The dimensions of a loading coil necessary for receiving *Sayville,* L. I.?

A. 1. We would advise you to construct a small auxiliary antenna parallel to the arc light transmission line, connecting the aerial to the ground. (This aerial is, of course, not used for wireless purposes.) Another method which you can use to eliminate the noises developed by the arc is to change the direction of your antenna. However, the former method would be preferable.

A. 2. A loading coil which will tune Sayville, L. I., station can be constructed by employing a tube which is 20 inches long by 5½ inches in diameter, fully wound with one layer of No. 22 B. & S. copper enamel magnet wire.

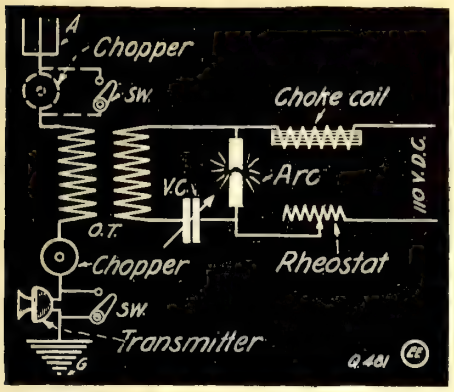
"CHOPPER" FOR ARC CIRCUITS.

(481.) Lloyd Bosserman, Pleasanton, Kan., sends us a diagram of a radio telephone set, on which he would like to have our opinion as to whether it is correct. 2. He also requests a diagram showing the connection of a "chopper" in the electric arc circuit.

A. 1. The diagram submitted is correct and you will no doubt find it satisfactory for operating over short distances.

A. 2. The accompanying illustration shows the connection for the "chopper." It can be connected in series either with the ground or with the antenna lead. When the station is to be used for the transmission of radio telephonic messages it is only necessary to short circuit the terminals of this instrument. You will undoubtedly find the "chopper" satisfactory for transmitting

radio telegraphic signals or for calling when using the arc for the production of high frequency oscillations.



Connection of "Chopper" in Radiophone Circuit.

RECEIVING RANGE.

(482.) Chester Barnes, Linton, Ind., wishes us to tell him: 1. How far he would be able to receive with the following instruments: Receiving transformer, rotary variable condenser, fixed condenser, 2,000-meter loading coil, Murdock detector, 3,000-ohm receivers. 2. Whether a loading coil increases the value of the receiving range. 3. The best detector for use in wireless telegraphy.

A. 1. With these instruments you should be able to receive 800 to 1,200 miles under favorable conditions. This can, of course, be increased by using a large antenna.

A. 2. A loading coil is only used for receiving longer waves than the natural wave length of your antenna. It is not necessary to tune for such unless the distant station is transmitting a longer wave length than your normal receiving set responds to.

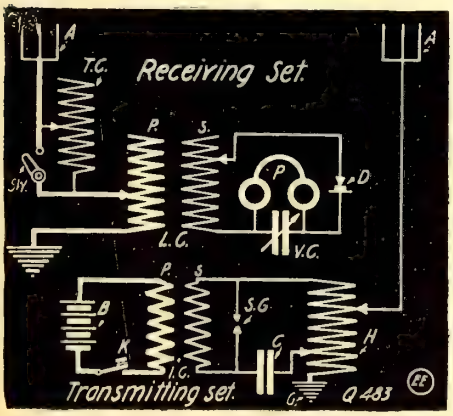
A. 3. The two best detectors used in wireless receiving stations are possibly the Audion and Radioson detectors.

RADIO HOOK-UPS.

(483.) Vincent Natalish, New York City, wishes to have: 1. A hook-up for the following instruments: A Navy type loose coupler, variable condenser, detector, 'phones and switch for cutting in a loading coil for increasing the wave length. 2. Diagram for a one-inch spark coil gap, helix, condenser or Leyden jars and key. 3. Information regarding which is preferable—Leyden jars or unit condensers of other types.

A. 1. The accompanying diagram gives the connections for the instruments you mention.

A. 2. The second illustration shows the



Radio Sending and Receiving Circuits.

connections for the transmitting instruments you have specified.

A. 3. It is more advisable to use sec-



"I Received Messages from San Francisco (2100 Miles) with CRYSTALOI"



"July 9th, while at anchor in Kahului Harbor, Hawaiian Islands, I copied K P H San Francisco Press with Crystaloi, at a distance of 2100 miles."
(Signed) A. H. RANDOW, Operator, S. S. Dakotan.

CRYSTALOI

The Highly Sensitive, Permanent

WIRELESS DETECTOR

Is Making New Records Like This Every Day

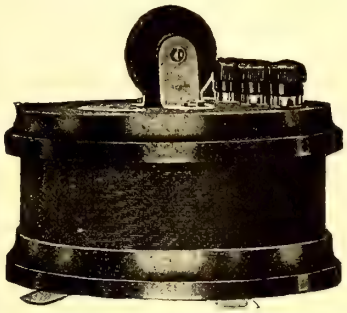
Crystaloi is the only practical wireless detector affording innumerable contact points. Due to its peculiar construction, embracing a very sensitive mineral which is brought into contact with a light, finely divided alloy, it is remarkably free from static and other interferences. Tests have shown that Crystaloi actually reduces static one-half. With proper use it will last a lifetime without repair, adjustment or attention of any kind.

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TYPE O—Dimensions 2¼" x 1⅞". **Price, $3.50.** Mailing Weight, 1 lb.

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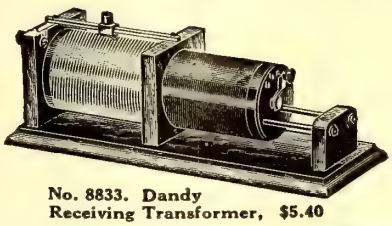
TYPE BB—Equipped with cohering inductance, fixed condenser, buzzer, test and frequency control. Dimensions, 7½"x 5½" x 3½". **Price, $12.00.** Mailing Weight, 4 lbs.



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All Live Dealers Carry Crystaloi. If your dealer cannot supply you, write us. Catalog "C," fully describing Crystaloi and all of our other High-Class Receiving Apparatus, sent on receipt of 5 cents in stamps.

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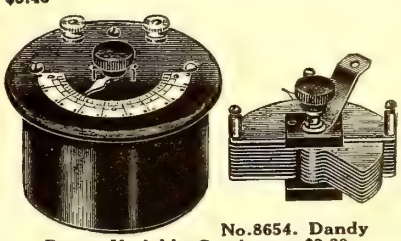


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Are *You* looking for *Quality—Design* and *Workmanship* consistent with price?

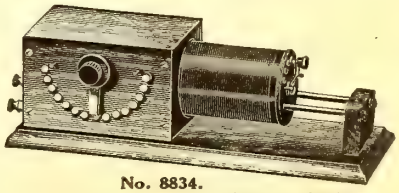
If you are, then get our catalog No. 36E. Illustrating and describing about **300** articles of Amateur-Radio Telegraph apparatus.

We also Manufacture
Telegraph and Fire Alarm Apparatus, Dry Batteries, Medical Batteries, Bells, Line Equipment, Novelties, Etc.



No. 8654. Dandy Rotary Variable Condenser, $3.30

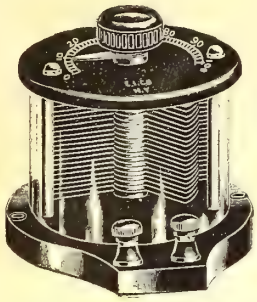
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Chicago Wireless Headquarters

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Only transparent rotary variable condenser made that can be screwed down, filled with oil to increase capacity and has binding posts on bottom where they belong. The 43 plate condenser has a capacity of .001 m.f. The 17 plate has a capacity of .0003 m.f.

No. 9240—17 Plate Rotary Variable Condenser, $2.25
No. 9241—43 " " " " 3.75



No. 10. TUNGSTEN FLASHLIGHT
6 inches long, complete .....**65c.**
Extra battery....**20c.** Extra bulb....**15c.**

60 and 100 Watt Nitrogen Lamps use less current; give white light.
60 Watt.....**85c.** 100 Watt.....**90c.**



No. 125. TUNGSTEN NICKEL VEST POCKET FLASHLIGHTS with Tungsten bulb and Ever-Ready Battery, complete.....**45c.**
Extra bulb, **15c.** Extra battery, **20c.**

FINE **50c.** POCKET CIGAR LIGHTER. Turn the wheel. Flint good for 5,000 lights. (2 for **25c.**), or each **15c.** New Flints, **5c.** 6 for **25c.**

We carry a very complete line of Wireless Apparatus in stock, being Chicago headquarters for the Electro Importing Co. Same prices, same goods and Free Wireless Course. Lionel Trains, Motors, Transformers, Wireless Outfits, Structo Metal Building Material, Automobile and Electrical Supplies. Send 4c. in stamps for complete catalogs.

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NEW WIRELESS WONDER

THE INSTANT RADIOGRAPH

Greatest invention of the Age. The result of years of experimentation.

Abolishes detector troubles and adjustments—
No more delays—no more lost time and messages

Pick up your receivers any time, Summer or Winter, in any atmospheric conditions and—

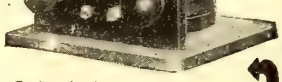
You Can Receive Instantly Without Any Adjusting

3,000 miles is latest record of the Instant Radiograph.

It is wonderful, but true, you cannot get the Instant Radiograph out of adjustment no matter how you knock it about. Try it yourself, hit it with a hammer while in use.

Vibrations, jars, knocks cannot affect it as there are no fine adjustments to make—no batteries—nothing to wear out—no operating expense whatever.

INTRODUCTORY PRICE FOR MARCH **$3.00**



Cut ¼ Actual Size.

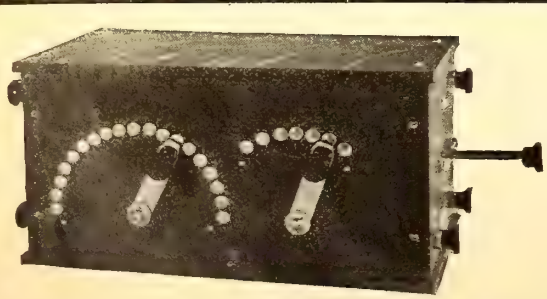
The Instant Radiograph is more efficient than any detector on the market, as there is nothing to adjust.

The Instant Radiograph is beautifully and solidly constructed on a heavy base of hard rubber 4 x 4 inches square with rounded corners and 4¼ inches high; binding posts are made of non-corroding metal, heavily silver plated, and have heavy rubber-covered thumb screws, preventing current leakage. **All contacts are large, non-corroding, heavily silver plated, of large size and will last a lifetime. This is a wonderful instrument of distinctive appearance that you will be proud to have in your wireless station.**

The Radiograph is the greatest recent invention in the Wireless field. Its value is priceless and as we want every professional and amateur operator on land and on board ships to use it, we have decided to make an introductory price of $3.00 for a limited time only. This is only one-third of the price at which it should be sold. Send your order at once. **Send for free Catalog E of the Instant Radiograph.**

You need this new book. "Radio Stations of the World." A complete authentic list of call signals of every public wireless station. Price, only 50c.

UNIVERSAL WIRELESS COMPANY, 19 East 32nd St., New York



This Selective and Efficient Tuner Only $8.00

"Your new tuner with switches is very satisfactory and much more selective and efficient than other type although that one does splendid work. Henry Wheat, Jr., Geneva, N. Y."

We also make a 10,000 meter tuner. Send 2-cent Stamp for Bulletin 107

Colby's Telegraph School
Auburn, N. Y.

tional condensers in a transmitting station than Leyden jars, as the former are less bulky.

TELEGRAPHONE QUERIES.

(484.) Joseph A. Wensk, Baltimore, Md., wishes to know: 1. Whether the plates and supports of the Telegraphone, which was described in the June, 1915, issue of *The Electrical Experimenter,* can be built of wood instead of aluminum? 2. Whether he can receive the Sayville station with the use of Dr. Cohen's new receiving set hook-up? 3. The quantity and size of wire required to build two coils, each have 15 ohms resistance.

A. 1. These parts could be satisfactorily built of wood, but the wear and tear on same is such that if they are built of aluminum they will last much longer.

A. 2. You will undoubtedly be able to receive the Sayville wireless station by the use of Dr. Cohen's improved hook-up if a proper inductance is added to your antenna circuit. We would advise you to obtain a very large inductance, having at least a wave length of 7,000 meters, as the wave length used by this station is about 9,000 meters.

A. 3. For building these coils we would suggest to use 640 feet of No. 36 B. & S. copper magnet wire.

DRY BATTERIES.

(485.) William Entress, Unionport, N. Y., wants to know: 1. The compound used in making dry cells and the quantity of same. 2. Whether a Geissler tube can be operated on a small medical coil?

A. 1. The moisture retaining compound used in constructing primary dry cells is: Ammonium chloride, 1 part; plaster of paris, 3 parts; zinc oxide, 1 part, and a sufficient amount of sawdust to cover the paste.

A. 2. A small medical induction coil will not operate a Geissler tube. You must use a coil giving at least a one-eighth inch spark.

LOOSE COUPLER.

(486.) Edward Updike, Niles, Mich., wishes us to tell him: 1. Whether a loose coupler would be improved if the primary of the coil were wound over an iron tube? 2. Whether a resistance should be connected in series with an arc.

A. 1. The primary coil of a loose coupler should never be wound over an iron core, as the impedance of the coil would be increased and thus inferior results would be obtained. However, other metallic tubes can be employed experimentally if desired, but careful insulation must be made between the tube and the winding. Also the tube should be slit longitudinally, to prevent eddy currents circulating through it. The iron core cannot magnetize and demagnetize fast enough for this purpose, resulting in a very low "power factor" and consequent loss.

A. 2. A resistance should invariably be used with the arc.

CHANGING A. C. TO D. C.

(487.) John T. Alderman, Jr., Henderson, N. C., wants to know: 1. Whether a ½-kilowatt radio transformer can be used for operating an X-ray or Tesla transformer? 2. Whether a buzzer transmitter can be made from an ordinary buzzer? 3. How 110 volt, A. C. can be converted into D. C.?

A. 1. A ½-kilowatt transformer can readily operate an X-ray or Tesla transformer, providing it is not too large.

A. 2. A buzzer transmitter can be made from an ordinary buzzer. However, larger coils should preferably be used in building such a device, so that a greater amount

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The VIOLETTA HIGH-FREQUENCY GENERATOR is used and endorsed by thousands of physicians. It generates the Violet-Ray High-Frequency Current which is used with wonderfully quick results for facial, scalp, and body treatments.

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Write for our beautifully illustrated booklet 62 G.

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REPAIRS—9 XE—SUPPLIES WIRELESS

Send us your Spark Gap Motors.
We repair any wireless instrument.
Our wireless repair men do this work.
IN STOCK—all kinds and makes of Tuners, Detectors, Phones, Transformers, Etc. Give us a trial. We answer letters.

9 XE-WIRELESS REPAIR & SUPPLY COMPANY
DAVENPORT, IOWA

8,000 MILES

is the record (amateur) with our Audio-Tron Detector

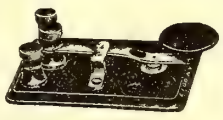
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DETECTOR—AMPLIFIER—OSCILLATOR

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RADIO APPARATUS and SUPPLIES
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25-WATT "WIRELESS" TRANSFORMER $15.00

Closed Core Type Self Contained 14,000 VOLTS 3 Different Powers Shipping Weight—20 lbs.

Folders and information descriptive of these ¼ K. W. transformers may be had for the asking—also of our 500 and 750 watt capacities.

Winger's Code Charts—large size **Continental—Post Paid—15c.**, small or pocket size **10c.** They enable you to learn the code **More Quickly** than by any other method.

Our New Detector (cat whisker type) is **"Some" Detector**—it is a marvel of simplicity and dependability—base is of **Vulcanized Fibre** and is furnished with **Two** crystal holders—one **Cupholder** and one **Looped Spring** holder—**Post Paid 50c. WINGER ELECTRIC & MFG. CO., 711 So. Dearborn St., Chicago, Ill.**

READ the Classified Advertisements in this issue. They are small but contain big bargains and opportunities.

of current can be supplied to the coils and thus a greater range obtained.

A. 3. There are two methods by which you can readily convert 110 A. C. to D. C. One is to employ a rotary converter of the electrical type or a mechanical converter. The second and easier method, although not as efficient for converting same, makes use of an electrolytic rectifier.

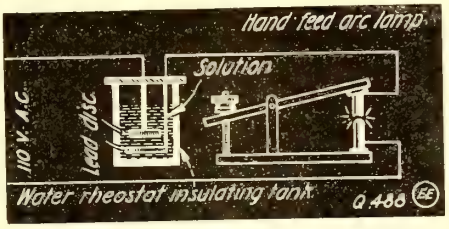
WATER RHEOSTAT.

(488.) Clarence F. Kramer, Lebanon, Ind., wants to know: 1. How many small incandescent electric bulbs can be lighted by the current generated from an ordinary three-bar telephone magneto? 2. How it is possible to step-down 110 volt, 60 cycle A. C. to such a voltage as would operate a hand feed arc lamp? 3. Whether it is possible to employ a water rheostat for reducing said voltage to the proper value for operating the arc lamp?

A. 1. Only by rewinding the magneto with, say, No. 24 enamel wire will you be able to light up about two six-volt, two-candlepower lamps. The ordinary magneto uses very fine wire, usually No. 36 or finer, with a resistance varying from 600 to 10,000 ohms. Such a magneto will not light a lamp.

A. 2. The 110-volt, 60 cycle A. C. can be reduced to a suitable value for operating a hand feed arc lamp by employing a water rheostat.

A. 3. You can readily use a water rheostat for reducing 110 volts. The accompanying illustration gives the method for connecting the rheostat.



Use of Water Rheostat in Arc Circuit.

USES FOR OLD PHONOGRAPH RECORDS.

(489.) H. M Clay, Shelbyville, Ky., wishes to know how he can melt old phonograph records so that he may use the molten material for making parts for wireless instruments?

A. The best method by which you can melt the phonograph records is to employ an ordinary carpenter's glue pot, filling the inner chamber with broken parts of the record and the external chamber with water and then applying a low heat to the pot. Care should be taken to see that the molten material does not burn, as it can readily catch fire and thus destroy its insulating properties. You will obtain better results with a good grade of stationer's sealing wax.

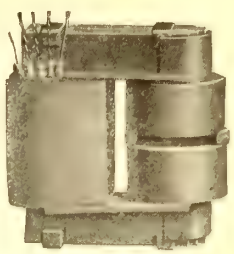
SPARKING UNDER DYNAMO BRUSHES.

(490.) H. A. Wright, West Barnstable, Mass., wishes us to tell him: 1. The size of wire to be used in building the armature and fields for a two pole, shunt wound dynamo developing 12 volts. 2. The cause of sparking at the commutator.

A. 1. We would advise you to use No. 28 wire on the field coils and No. 26 copper magnet wire on the armature coils.

A. 2. The cause of sparking under the brushes may be due to several reasons, some of which are as follows: The brushes possibly may not be set correctly, pressing too hard or unevenly against the commuta-

(*Continued on page 727.*)



UNMOUNTED TRANSFORMER

You Can Get Results

with a small condenser and this transformer

It is a 1-2 K. W. size and is built on the same specifications as to material and workmanship, etc., as our big central station transformers.

Hundreds of stations are now using these transformers. This transformer gives you 13,200 volts.

Let us tell you how you can do part of he work yourself and get this transformer at a remarkably low cost.

THE PACKARD ELECTRIC CO.
555 Dana Avenue Warren, Ohio



Type AML

The Precision Varicoupler

Patented Mar. 7, 1916, foreign patents pending.

Up-to-date receiving circuits require improved apparatus. You can't get supersensitiveness with old style couplers. The Precision Varicoupler is PERFECTION in receiving tuners. It has

No Taps	**No Sliders**
No Switches	**No Delicate Parts**
No "Dead Ends"	**All the Wire in**
No Contacts	**Use all the Time**

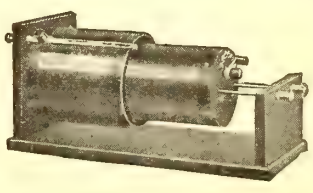
and is finished in mission oak, genuine cut hard rubber, silver finished wire, etc.

5 Styles, $10 to $25

For detailed information write for bulletin PL.

The Precision Radio Equipment Co., Inc.
General Office: 868 Putnam Ave., Brooklyn, N. Y.

LOOK! A NEW CHAMBERS COUPLER No. 744, PRICE ONLY $4.50

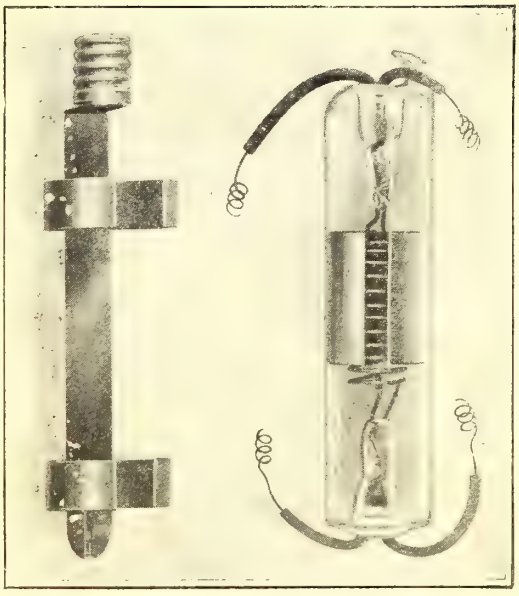


Positively unequaled for the money. Is 6" high, 6" wide, and 14" overall. Wound with Enameled wire, and has a very unique slider. Woodwork mahogany finished. Try one, you will not be disappointed.

5c. in stamps brings our 64-page illustrated catalogue, B-B-24. None otherwise.

F. B. Chambers & Co. 2046 Arch Street Philadelphia, Pa.

The Great Announcement



THE NEW TUBULAR AUDION BULB will be sold SEPARATE from our instruments, taking effect March 15th.

This bulb brings in signals very loudly.
It has a single, straightline filament of very long life and is certain to be a very popular type. Made in one grade only, every bulb passing our usual and careful test.

To those who cannot afford our complete detectors with round bulb, this offer will be of immense interest.

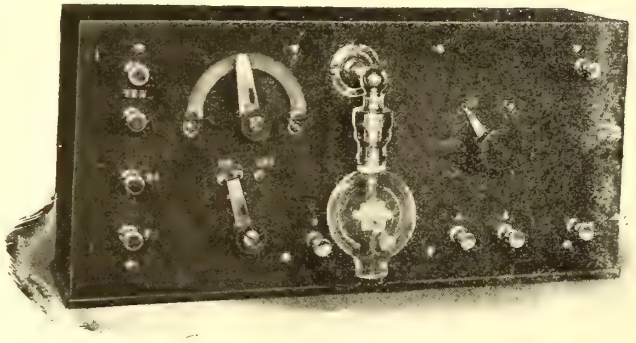
Price—$5.50 each, postpaid, or from any of our 45 distributors.

The adapter illustrated above is not furnished with the bulb, but is 40 cents extra. It adapts the bulb to a regular screw socket.

ROUND AUDION BULBS will still be sold, as heretofore, as renewals only for De Forest instruments, and only on return of the old bulb.

NEW BULLETIN X16 on the type T, Tubular Audion Bulb, will be sent if you enclose stamp.

Type RJ8



PRICE, $25.00

New De Forest Audion Detector

THE BEST AUDION DETECTOR EVER OFFERED FOR PRIVATE USE

¶ The Audion Detector is the most sensitive detector in existence. (Bulletin U. S. Bureau of Standards, Vol. 6, No. 4, Page 540.) The new and improved forms are more sensitive, more reliable and more adaptable than ever before. The new Type RJ8 Audion Detector represents the greatest value for the money ever offered.

¶ It is equipped with **potentiometer** control for the high voltage circuit, giving extremely close regulation which is so essential to obtaining utmost efficiency with the Audion. It is a **panel type** instrument of the very best construction. It is thoroughly reliable and constant in operation, is not affected by mechanical vibration or by the transmitting spark, and is **always** to be depended upon for reception of signals over the greatest possible ranges.

¶ It is worth a stamp for you to be informed on this and the other new De Forest instruments.

"There is only ONE AUDION—the DE FOREST"

Send stamp for M 16 Bulletin on the New Audions

De Forest Radio Telephone & Telegraph Co.

101 PARK AVENUE, NEW YORK CITY

QUESTION BOX.

(*Continued from page 725.*)

tor, bearings too loose, short circuited segments, loose segments, overloading and overheating of the armature coils. Sometimes carbon brushes are gritty. Boil them in paraffine wax. Try carbon or graphite brushes with woven copper wire centers. Carbon brushes often have too high a resistance.

CONSTRUCTION OF PHONOGRAPHIC CYLINDERS.

(491.) James Fitzpatrick, Darlington, Pa., wants to know: 1. Whether a buzzer set operated by flashlight batteries can be used for exploding photographic flashlight powder? 2. How phonographic records are made?

A. 1. A buzzer set with sufficient amount of flashlight batteries and properly connected can successfully be used to explode the photographic flashlight powder.

A. 2. It would be impossible for us to go into the details of the construction of cylindrical phonographic records, as the process is somewhat complicated for explanation in our Question Department. However, we would say that a soft record plate is first produced and from this a metallic mold is built, in which all duplicates are made. We would advise you to write to several phonographic record manufacturers of this country and ask them to give you data as to the construction of their records. They may probably give you a general description of the method they use.

PHOTOGRAPHIC PLATES.

(492.) Francis Crump, Jr., Columbus, Ind., wants to know: 1. The chemicals used in making photographic plates. 2. The chemicals employed in manufacturing gaslight printing paper and how it is prepared.

A. 1. Photographic plates are made out of glass upon which a coating of gelatinous silver bromide is applied. The coating of this material is sensitive to light if applied in a darkened room.

A. 2. Gaslight printing paper is usually made with silver chloride in which a small trace of silver bromide is added. This material is mixed with a gelatinous compound and applied to sheets of paper.

WIRELESS IN FAR NORTH.

Wireless telegraphy will be used instead of the old poles and wire by the new Canadian Government Railway which is to connect Hudson Bay with the Canadian Northern at Le Pas, Manitoba.

A chain of wireless stations is already constructed between Port Nelson and Hudson Straits. When put into operation they will mark a new era in railroad telegraphy, for no other road depends solely on wireless over so long a stretch of territory.

There now remains only 100 more miles of grading to be done to complete the road bed from Le Pas to Port Nelson.

TUFTS COLLEGE HAS NEW HIGH POWER RADIO STATION.

(*Continued from page 700.*)

very latest design, wonderful testing instruments of a very delicate nature, and a perfect set of machinery for experimental purposes. The advantages in using only one aerial, according to Harold J. Power, head of the Atlantic Radio and Research Corporation, comes from the fact that the operators are better able to transmit messages to all points of the compass equally well.

The laboratory is practically sound and vibration proof, allowing the use of the most delicate testing instruments, a very important factor of the research work now being carried on there. Each room was carefully tested by Mr. Power with a microphone. The heavy machinery in the basement was turned on at full power, and not the slightest vibration could be detected in the room above.

On the northerly and westerly sides is the experimental laboratory well supplied with windows, so placed as to get the maximum light on the benches. In the machinery room the base, main shafting and pulleys are set solidly in the concrete floor, while the counter-shafting is bolted to a shelf, reinforced with steel brackets, so placed that rubber shock absorbers may be inserted between them and the floor if necessary.

A large assortment of the latest design testing instruments are to be found in this laboratory. These meters are so delicate that the minute current produced by placing the fingers on the contact buttons is recorded. The floors are all double and lined with heavy layers of felt. The doors are double soundproof. The Tufts Wireless Society will have a room in the building and eventually the plant will revert to Tufts College, together with all the costly instruments and machinery.

The credit for this addition to the electrical equipment of Tufts College, which has long been famous for the electrical engineers it has turned out among its graduates, and which was one of the first colleges in the country to take up radio research work, is due to Harold J. Power, a former student at Tufts and later a wireless operator on various steamers on the Atlantic.

Mr. Power started in wireless experimental work when wireless telegraphy was first being used on a commercial scale; Marconi, a few years previous, having published the results of his early experiments. Young Power, after weeks of hard labor, managed to construct a crude, but very complete wireless transmitting and receiving set. His "laboratory" consisted of a shack in the rear of his home. Little did he realize that 12 years later he was to sit down in a fine modern laboratory of his own and take down a message from Berlin, 4,000 miles away.

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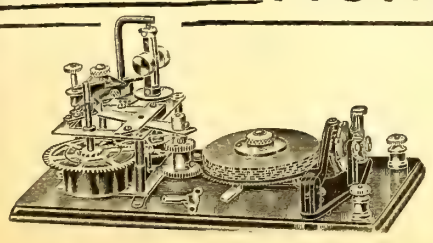
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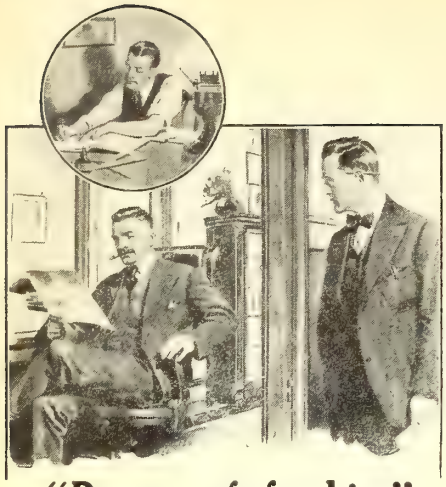


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ELECTRICAL LOSSES IN TRANSMITTING AND RECEIVING SETS.

(*Continued from page 702.*)

frequent source of trouble. Ground connection should be made to moist earth only. If the earth around the station be sandy and dry, a *counterpoise* ground may be resorted to. This is made by stretching a wire netting similar, if possible, in shape and dimensions to the antenna just above the ground and insulated from it. The netting should be placed directly under the antenna to secure best results. Such a ground is used for military portable stations with very satisfactory results.

(*To be continued.*)

HOW TO ORGANIZE AND CONDUCT A RADIO CLUB.

(*Continued from page 699.*)

fecting himself alone. A member has a right to change his vote, if not by ballot, before the final result is announced, but not afterward.

ORDER IN DEBATE.

When a person wishes to speak he must rise in his seat, address himself to the chair, who must recognize him by name, thus giving him permission to speak. If several should arise at the same time the chairman must signify who shall speak first. No member should be allowed to speak more than twice, except to give a mere explanation, without special leave of the house, and the time a speaker may hold the floor is unlimited unless there is some rule of the organization limiting the speakers. If the chair rises to speak, the person standing must sit down until the chair has finished. In referring to another member it should not be by his name, but as "the previous speaker," "my opponent" or some such descriptive phrase. When a member is called to order he should sit down and not attempt to speak again until he has permission from the chair.

ORDER OF EXERCISE.

After an organization is effected the order of exercises adopted depends upon what is best suited for that body's deliberation. 2. Roll call. 3. Reading, approval, correction and adoption of the minutes of previous meeting. 4. Reports of standing committees. 5. Reports of special committees. 6. Unfinished business. 7. New business. 8. Communications. 9. Orders of the day. 10. Election of officers. 11. Reception of new members. 12. Announcements. 13. Adjournment.

PARLIAMENTARY DON'TS.

Don't attempt to discuss a motion until it has been stated by the chair.

Don't antagonize unnecessarily; nobody loves a barking dog even if he doesn't bite.

Don't be carried away in debate by a fervor or frenzy; moderation will win your cause most surely with reasonable minds, and your opinion will carry more weight. Speak slowly and distinctly.

Don't be too exacting to have the letter of the law enforced.

Don't forget that the common laws of politeness and respect due your fellow man obtain just the same in the society hall as in the drawing-room, even if the by-laws of the organization have no definite ruling on these points.

Don't cheapen your opinion in the eyes of others by speaking too often or upon every occasion. Keep quiet until you have something to say and a good reason for saying it.

Preface a motion with "I move that."

Don't leave it to the chairman to handle a motion relating especially to himself. The secretary or maker of the motion should state the question, put it to vote and announce the result.

(*Continued on page 730.*)

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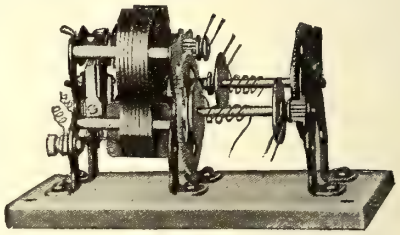
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PATENT ADVICE

Edited by H. GERNSBACK

In this Department we will publish such matter as is of interest to inventors and particularly to those who are in doubt as to certain Patent Phases. Questions addressed to "Patent Advice" cannot be answered by mail. Sketches and descriptions must be clear and explicit. Only one side of sheet should be written on.

WIRELESS DEVICES.

(50.) L. H. G. submits several ideas regarding rotary spark gap, quenched spark gap, hot-wire ammeter, and wishes to have our advice. He also wishes to know if, in case the devices are patentable, they could be sold for a reasonable sum without first obtaining a patent.

Our correspondent has an idea to increase the efficiency of a quenched spark gap by inclosing the entire gap in a certain gas, and wants to know if this would increase the efficiency of the gap.

A. A quenched gap will not work as well when inclosed in gas, for the reason that it will not be air-cooled as well as if it were under ordinary atmospheric pressure. For that reason it would work less efficiently.

On his rotary variable condenser a certain number of circular plates are mounted on two horizontal insulated rods. More or less plates can be placed in the circuit.

A. We do not see anything new in this condenser, as a similar one is already on the market, and the difference in the construction is not great enough to warrant your obtaining a patent.

As to the hot-wire ammeter, we believe its construction to be faulty, and we doubt if a patent can be obtained. As to the other question, we would never advise anyone to sell or offer for sale an invention without having first applied for a patent on same. It is a risky thing to do, and the inventor frequently loses the title to his invention.

EMPLOYES' INVENTIONS.

(51.) C. J. Conner, Coatesville, Pa., wishes advice on the following:

Can an employer, whether a corporation or individual, claim an invention made by one of his employes and patented by said employe, the latter not using the time or material of the employer when developing the invention, and further, the employe paying for the patent.

A. If the invention has not been developed on the premises of the employer he has no right to the patent, if obtained by the employe. Only by working on the employer's premises, using his tools and equipment, etc., can an employer actually claim title to an employe's invention. We would suggest that you write to a patent attorney and obtain detailed information on the matter.

NON-OXIDIZING CONTACT.

(52.) W. Rademaker, Hoboken, N. J., wishes advice on the following questions:

1. Having applied for patents on an absolutely water-dust-rust-fire-etc.,-proof nonoxidizing and unexplosive contact or circuit breaker, what would be, according to your opinion, its commercial value or field of application?

A. 1. It is impossible to say what the commercial value of the contact of this kind would be without knowing the composition of it. Just by having a contact fireproof means nothing, as some contacts are used under a very great heating stress where even platinum, which has a very high melting point, wears away in time. Tungsten is being used, as it has a very high melting point, but it is not very suitable on account of its being too brittle.

2. Are exposed circuit-making devices, such as rail, fire-alarm signals, bells outside, frequently inoperative on account of atmospheric influence, ice, sleet, etc.?

A. 2. Yes.

3. Are there any contacts on the market which work by a sliding member in an airtight space?

A. 3. To our knowledge there are quite a few such contacts on the market. We believe the idea is a common one.

NEW DETECTOR.

(53.) Carter Pietsch, Bloomington, Ill., submits a new scheme for a wireless detector which is supposed to operate by using certain metallic members and certain magnetic windings surrounding these members. Our correspondent wants to know if this detector will work, also if it is patentable. He also would like to know who the most reliable patent attorney is to whom he might submit the idea.

A. Without trying out a scheme of this kind it is wholly impossible to say offhand whether it would work or not. Would advise our correspondent to have a sample made up and tested, and if it works we think a patent can be obtained, for the idea is rather novel. As to patent attorneys, any patent attorney advertising in this magazine can be trusted implicity.

LOOSE COUPLER.

(54.) Oscar Taman, Chicago, Ill., submits drawing and specifications of a new long-wave loose coupler, and means are provided to entirely eliminate the dead end effect on long waves. Several moving tubes with wire are used in order to accomplish this. Inquirer desires to know whether his idea is patentable.

A. A loose coupler similar to the one you show is already on the market, and we do not think a patent could be obtained on your design.

Give the same thoughtful attention to the other fellow's ideas that you would have him give to yours, for in that way you not only learn more, but make more friends while you are about it.

PATENTS

IF YOU HAVE AN INVENTION which you wish to patent you can write fully and freely to Munn & Co. for advice in regard to the best way of obtaining protection. Please send sketches or a model of your invention, and a description of the device, explaining its operation.

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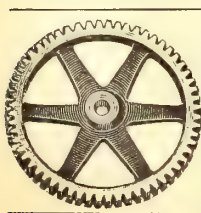
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HOW TO ORGANIZE A RADIO CLUB.

(*Continued from page* 728.)

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While we do not wish to go on record as saying that books will teach everything, and further that we thoroughly believe in having every member of amateur clubs do some practical work with apparatus owned by the club or build some special instrument under the instruction of the club's instructor or engineer, yet we do wish to say that there is nothing more important for any such organization, whether large or small, than a good library. It may consist of six books or a hundred. At any rate, shortly after the club has been started on its mission the idea of forming a library should be promulgated and brought before the members. Besides books, a very important source of information is the magazines and periodicals available on the subject. These should be subscribed for at once, so that one or more copies will come to the reading table of the club each month.

The Electrical Experimenter is the leading wireless journal available to-day, and the following should also be subscribed for whenever possible: *Wireless World,* published by the Marconi Press Agency, Marconi House, Strand, London, W. C., England; *The Electrical World,* published by the McGraw-Hill Publishing Co., 239 West Thirty-ninth street, New York City, which very often publishes excellent engineering articles covering radio telegraphic developments of vital importance and interest to all live radio amateurs and operators.

The manager of the Radio League of America will be glad to advise anyone interested in this work as to where the best books, as well as the most reasonably priced ones, can be obtained on the subject of radio telegraphy and its allied branches. We give below a brief list covering the more important books on wireless furnished prepaid by the book department of *The Electrical Experimenter.*

LIST OF RADIO CLUB LIBRARY BOOKS.

Operator's Wireless Telegraph and Telephone Handbook. By Victor H. Laughter	$1.00
Wireless Telegraphy and Telephony Simply Explained. By Alfred P. Morgan	1.00
Elementary Manual of Radio Telagraphy. By Dr. J. A. Fleming	2.25
The Design and Construction of Induction Coils. By Frederick Collins.	3.00
Principles of Wireless Telegraphy. By Dr. George W. Pierce	3.00
The Principles of Electric Wave Telegraphy. By Dr. J. A. Fleming	7.50
Wireless Telegraphy. By Dr. J. Zenneck	4.00
Experimental Wireless Stations. By P. Edelman	1.50
Wireless Telegraphy and Telephony. By C. I. Hoppough	1.50
Manual of Wireless Telegraphy for Naval Electricians. By Lieut.-Commander S. S. Robinson, U. S. N.	1.50
Practical Uses of the Wave Meter in Wireless Telegraphy. By Lieut. J. O. Mauborgne, U. S. A.	1.00
Wireless Telegraphy and High Frequency Electricity. By H. La V. Twining, A.B.	1.50
Electricity at High Pressures and Frequencies. By Henry L. Transtrom	2.00
Experiments with Alternating Currents of High Potential and High Frequency. By Dr. Nikola Tesla	1.00
The Book of Wireless. By A. Frederick Collins	1.15
Construction of Induction Coils and Transformers. By Thomas Stan-	

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REVISED LIST OF AMATEUR RADIO CLUBS.

(*Addition to list published in March issue.*)

Arlington Radio Club, Arlington High School, Arlington, Mass. Secretary, Harold O. Bixby, 65 Hillside avenue, Arlington, Mass.

Graceland Wireless Club, Graceland College, Lamoni, Iowa. Secretary, Jesse Roth, Graceland College, Lamoni, Iowa.

Inter-City Radio Association, Allentown, Pa. Secretary, William J. Kreis, 623 N. Penn street, Allentown, Pa.

Iowa City High School Radio Club, Iowa City, Ia. Secretary, Alan C. Rockwood, 1011 Woodlawn avenue, Iowa City, Ia.

Lewiston Radio Club, High School Building, Lewiston, Idaho. Secretary, George Barrett, 925 Eighth avenue, Lewiston, Idaho.

Louisville Radio Club, Louisville, Ky. Secretary, H. D. Brailsford, 323 W. Broadway, Louisville, Ky.

Oklahoma Radio Experimental Association, 1109 N. Francis Street, Oklahoma City, Okla. Secretary, Clifford A. Smith, 922½ W. Main street, Oklahoma City.

Peoria Radio Club, Peoria, Ill. Secretary, Ronald Mooberry, 915 Sanford street, Peoria, Ill.

Scott High School Radio Club, Scott High School, Toledo, O. Secretary, Watson Snell, 2555 Scottwood avenue, Toledo, O.

Society of Radio Research, Atlanta, Ga. Secretary, A. B. Corey, 379 N. Jackson street, Atlanta, Ga.

St. Louis Radio Club, St. Louis, Mo. Secretary, Fred Best, 4104 Easton avenue, St. Louis, Mo.

Two Hundred Meter Club, Newtonville, Mass. Secretary, Herbert Hovendon, 42 Austin street, Newtonville, Mass.

U. of W. Radio Club, University of Washington, Seattle, Wash. Secretary, F. M. Ryan, 4524 University boulevard, Seattle, Wash.

Waco High School Radio Club, Waco, Tex. Secretary, Paul M. Duby, 535 Proctor street, Waco, Tex.

Notice: To ensure proper entry of club registrations in our revised monthly list be sure to send us at once the data outlined below. Such information should reach us not later than the 28th of the month for entry in the succeeding issue of THE ELECTRICAL EXPERIMENTER.

Name of Club.....
Location (street and city).....
Founded .....
No. of Members.....
Meeting Date.....
Power of Club Set, if any.....
Call Letter (licensed?).....
Dues and Initiation Fee.....
Secretary's Name and Address.....

BOOK REVIEW.

SELF HELPS FOR THE CITIZEN SOLDIER. By Capt. James A. Moss and Capt. Merch B. Stewart. Cloth covers, 240 pages, profusely illustrated. Published by George Banta Publishing Co., Menasha, Wis. Price, $1.25.

"We must depend in every time of national peril in the future as in the past, not upon a standing army, nor yet upon a reserve army, but upon a citizenry trained and accustomed to arms."

These words from President Wilson in his message, December, 1914, convey the thought of every thinking leader from Washington down to the present day. The present book is directly in line with such principles, and although it does not teach the citizen to be a soldier, it gives him information on the rudiments of what is required of soldiers, and by intelligent reading, he can clearly understand his duties and will fit smoothly into the military scheme.

The subject of our deficient defense receives attention in the forepart of the book, from which it goes on to explain the duties of a soldier. The book is well illustrated with photographs of soldiers in camp, on duty and at play. Pen pictures are used to caricature some false ideas and give the proper touch of light matter that relieves the seriousness of the book, yet brings home its importance in a very vivid manner.

Rules of hygiene and health are suggested to harden the citizen; full details of the National Rifle Association of America are given, as well as the rules under which arms and ammunition may be obtained without cost for rifle practise.

The planning and carrying out of a battle are described to impress upon the mind of the reader the importance of every man doing his best at all times, and how really important each cog is in a perfect machine.

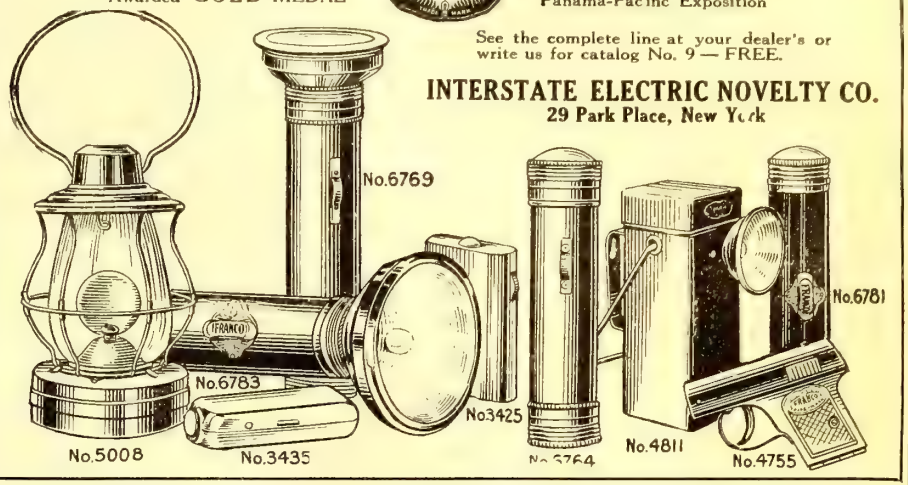
The volume is written with a high ideal in mind by men who are working toward those ideals, and its true value may never be realized till the cessation of the present war leaves us rich, yet unprotected, while the foreign coun-

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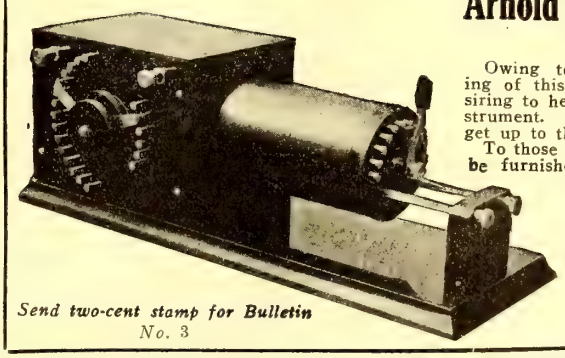
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tries will be poor and in debt, but equipped with a mighty war machine that can only be met with men who handle a rifle as well as they do a cane.

The Radio League of America was formed with a similar idea of preparedness in mind. This book will be of great service to members of the League who realize their duty to the country in time of peril, enabling them to grasp clearly the part they will have to play in the mighty drama of war, should this harbinger of sorrow ever visit our fair land. It is a step in the right direction and the only criticism is that many more and interesting details might be incorporated in its make-up.

THE ELEMENTARY PRINCIPLES OF WIRELESS TELEGRAPHY. By R. D. Bangay. Cloth covers; 7⅜x5 inches; 155 pages; 86 illustrations. The Marconi Publishing Corporation, New York City. Price, 35 cents.

Amateurs, as a class, have been waiting for such a book. It contains no "how-to-make-it" or construction data on apparatus, but confines itself to a clear and lucid explanation of high frequency phenomena in its relation to wireless telegraphy.

The reader will marvel at the ease with which the writer takes him through the book, explaining the operation of the different apparatus used in a manner not made tiresome by reiterations, useless words or flights of fancy so often indulged in to make a book imposing.

The elementary phenomena of electricity and magnetism is dealt with but only in so much as it refers to the subject on hand, and the student quickly picks up the theory of the art.

All of the apparatus used at the present time is explained in language that is concise and untechnical.

HANDBOOK OF TECHNICAL INSTRUCTION FOR WIRELESS TELEGRAPHISTS. By J. C. Hawkhead; revised by H. M. Dowsett, A.M.I. E.E. Cloth covers; 5¾x7¾ inches; 295 pages; 242 illustrations. The Marconi Publishing Corporation, New York City. Price, $1.50.

The vast number of Marconi stations on shipboard and the many recent improvements in same has made necessary a revision of this work as originally written by Mr. J. C. Hawkhead. The aim of this treatise is to put into the hands of the ship radio operator a book that will be of assistance in giving him a solid foundation on which to base phenomena noted in practical work.

The suggestions incorporated in the book are not only of use to the commercial operator but could be followed with profit by amateurs interested in having up-to-date and efficient stations.

All types of apparatus used by the Marconi Co. are portrayed and explained, both the care and operation up to and including the multiple type tuners and 5 K. W. transmitting sets.

Quite a large amount of space is allotted to the explanation of elementary electricity, thereby forming a solid basis for other information included in the work.

LIST OF RADIO STATIONS OF THE WORLD. By F. A. Hart and H. M. Short. 220 pages; 8¼x5½ inches; cloth bound; 35c. Supplied by The Experimenter Publishing Co., New York City.

This book is divided into four parts and arranged so any operator may easily and quickly locate the call of any station desired, or on the other hand, just as easily determine the name and position of any station sending a call that is heard through a wireless set.

The first part lists all radio stations of the world, land and ship, alphabetically by their calls and this list is corected up to May, 1915. By means of this list it is possible to trace any call to the station of its origin.

The second part lists naval stations alphabetically by country and vessel, while part three lists commercial ship stations by vessels, giving owner, nationality and control.

The last section contains a list of coast stations, arranged alphabetically by country and station.

The book is printed on high-grade paper in large, easily read, type and is a valuable addition to any radio station, commercial or amateur. Being practically indispensable when accurate data is required for calls heard or stations that are to be communicated with, and still within the reach of every one, it should find a ready demand.

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THE CHEMISTRY OF THE STORAGE BATTERY.

(*Continued from page* 711.)

either in the plates themselves or in the electrolyte, these normal reactions may be departed from. The impurities which may damage a battery are of three kinds:

IMPURITIES.

First—Foreign metals, or salts of such metals, especially such as are less electro-negative than lead, i. e., copper, silver and platinum. They are immediately precipitated on the negative plate and form, with the negative active material, innumerable points at which local action takes place. The spongy lead is, by this action, converted into lead sulphate, free hydrogen gas being evolved at the foreign metal. This action is greater the greater the quantity of metallic impurity and the more readily hydrogen gas is thrown off its surface. Platinum is the worst of the metals in this respect. A familiar example of this action is the following: Chemically pure zinc is but very slowly attacked in dilute sulphuric acid. On the addition of a mere trace of copper sulphate, copper is precipitated on the zinc, creating local action, and the zinc is violently attacked with the evolution of free hydrogen gas.

Second—Metals such as iron or manganese, whose salts are readily oxidized or reduced. Iron or ferrous sulphate is, for example, readily oxidized to ferric sulphate in contact with lead peroxide, while the ferric sulphate is again reduced to ferrous sulphate in contact with the spongy lead, each of these actions being accompanied with loss of charge of the corresponding plate and the formation of lead sulphate. A considerable quantity of iron or manganese will rapidly discharge a battery in this way.

Third—Foreign acids or salts of these acids or acid-forming substances. The effect of these substances is a rapid corrosion of the grids. The presence of such acids, even in minute quantity, must be avoided.

It is on account of the above actions that care should be taken to use only such acid and water as are known to be pure.

PUPIN'S NEW NON-INTERFERENCE ANTENNA.

(*Continued from page* 701.)

quency higher than a given range of frequencies. The station becomes then an ear which is quite sensitive for frequencies which are in the vicinity of the signaling frequency, but which is stone deaf to frequencies which are considerably beyond the range, as most static disturbances are. Similarly, a sectional wave conductor can be constructed which is quite responsive to frequencies in the vicinity of the signaling frequency, but absorbs almost completely everything below this range. My theoretical and experimental investigations encourage me in the belief that a perfect barrier has been found against disturbances due to the so-called static, and that the distances of uninterrupted wireless telegraphy and telephony will be very greatly increased.'

RECTIFICATION NOTICE.

We are advised by Casimir Jaroszewicz, who recently submitted a contribution for the monthly station contest in the February, 1916, issue of *The Electrical Experimenter*, that the radio set there described over his name is owned by Harold Burbridge, 6109 South Green street, Chicago, for which party Mr. Jaroszewicz prepared the article.

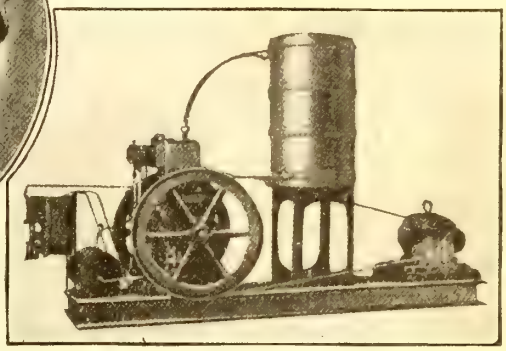
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This 1916 edition contains a complete classified list of all the U. S. Patents granted for wireless telegraphy, telephony, and control from the beginning to date, together with a discussion of the more important recent patents. This gives the key to the entire art and no experimenter can afford to be without it.

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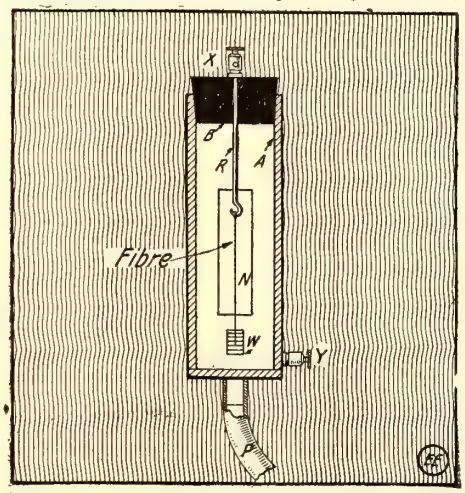
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PLATING QUARTZ FIBERS BY A CATHODE SPRAY.

The construction of many sensitive electrical instruments necessitates having a conducting support which shall be very light, besides having a constant torsion. This usually takes the form of a quartz fiber and many schemes have been used to render this substance a conductor, among which can be mentioned the method of spraying metallic particles on the fiber proper by mechanical means and also by electroplating platinum on the fiber.

Advantage was taken of the cathode discharge noticed in connection with Crookes' tubes in devising a new method of plating quartz fibers, which requires more or less extensive apparatus, but the illustration herewith gives a good idea of the process. An aluminum or glass tube is shown at A which has a rather thick wall. In the bottom is sealed a pipe P which is attached to a vacuum pump of any desired type, but it must be powerful enough to create a high vacuum in the chamber. The plug B in the upper end is ground into its seat to make an air-tight joint, and vaseline is used to seal this joint. The center of the plug is hard rubber surrounded by a ring of brass,



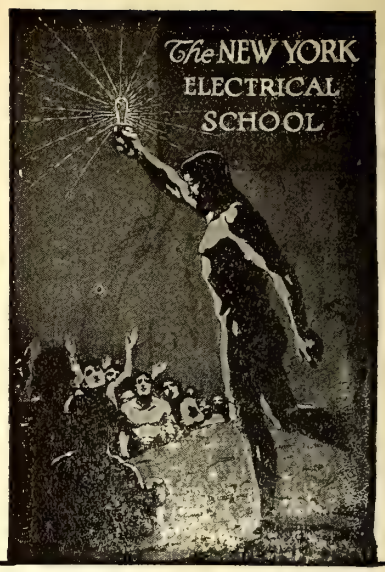
Apparatus Used to Plate Quartz Fibers by a Cathode Spray.

while through the center of it passes the rod R. Supported from the lower end of the rod R is the fiber which is to be plated with platinum. This fiber is kept taut by the weight W. At N is shown a sheet of the platinum foil which is fastened to the side of the cylinder if the tube is of aluminum. Should the tube be made of glass a platinum wire is sealed into the glass to make connection to the foil.

In operation the device acts in the following manner: Hydrogen is admitted to the chamber and the vacuum pump is then started, which creates a rarefied atmosphere of hydrogen. The terminal X in the plug is connected to the positive pole of the induction coil or transformer and the terminal Y is connected to the negative pole. When the coil is in operation according to the phenomenon taking place in a Crookes' tube the cathode rays will be thrown off from the tube toward the center. If the tube is made of aluminum there will be very little, if any, aluminum deposited on the fiber, whereas the platinum foil will have fine particles torn off and forcibly deposited on the quartz.

It is advisable to turn the plug at frequent intervals, so that all sides of the fiber will be acted upon by the platinum. This turning of the plug may be eliminated by coating the entire inner surface of the cylinder with platinum, but this makes the apparatus much more expensive to construct.

The resulting film of platinum on the fiber will be found to be very coherent, thin and of comparatively low resistance.



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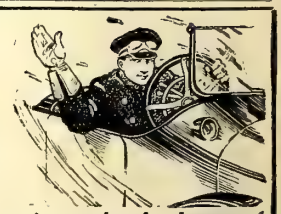
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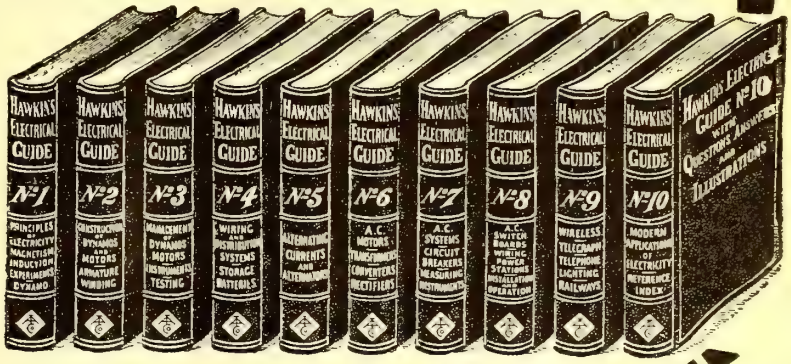
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MARVELS OF MODERN PHYSICS.

(*Continued from page* 698.)

region of the ultra-violet than in that of the infra-red. These are the waves which often prove harmful to the eyes, but on the other hand their great germicidal power has been successfully harnessed by a Danish physician, Finsen, who achieved remarkable success in the treatment of skin diseases and cancer with them. In medical circles the name *Finsen Rays* has been given to the ultra-violet rays used by him.

The production of ultra-violet light is simple. The ordinary arc light is rich in it, but as ordinary glass cuts off these rays, the globe is generally made of quartz.

So far we have said nothing about the X-ray or the invisible radiations given off by radio-active substances, because this is where we come in contact with the other great class of invisible radiations, consisting of fine, rapid-moving particles of matter, and it was long a mooted point as to which class X-rays themselves belonged.

The Crookes' tube was one of the first vacuum tubes to be used in connection with electric discharges. It consisted of a bulb-shaped tube and two electrodes, as in Fig. 3. Plücker discovered the fact that certain rays were given off at the cathode, and these were found to be minute particles having a *negative* electric charge. Later Goldstein discovered the canal rays, or rays given off at the anode, which travel much slower and are *positively* charged. Not until 1895 did Röntgen discover that still other rays were given off at the anode, and on account of their unknown character he termed them the *X-rays*. On account of the fact that they could neither be refracted, reflected nor polarized he thought them to be different in nature from light waves. It is known now, however, that ether waves may be either periodic trains of waves or irregular pulses, very short, and that irregular pulses may not necessarily be subjected to the laws governing ordinary periodic trains. Consequently it seems quite well established that the X-rays are very short, irregular, transverse disturbances in the ether caused by the electrons bombarding the positive target in the tube. It is further thought that the X-rays, on account of their length, should be placed about the ninth octave above the visible spectrum.

As for the radio-active substances, of which uranium is one of the most active, the invisible radiations are quite similar to those of the X-ray tube. These emanations were originally called Becquerel rays, after the scientist who first noticed them. However, instead of one, there are three distinct kinds of rays, known as the alpha, beta and gamma rays (α, β, γ). These *alpha rays* consist of a stream of positive particles, while the *beta rays,* which are more penetrating, are identical with the cathode rays mentioned before. The *gamma rays* are extremely penetrating, and appear to be quite similar to X-rays.

Thus it is seen that the invisible radiations of the radio-active substances are composite. The remarkable feature is that they originate spontaneously and that though they may be given off for a long period of time the action does not seem to materially decrease. In order to aid in distinguishing between the different rays they are shown diagrammatically in Fig. 4.

One more interesting phenomenon in connection with invisible radiation is the property of certain substances known as *fluorescence.* Such substances are really light transformers; that is, they transform invisible waves to such lengths that they are visible. Beautiful color effects can be obtained by throwing ultra-violet light on such substances.

One of the most important results of the present-day study of invisible radiations is the bearing these results have on our theories of the ultimate constitution of matter. In the case of radio-active substances the atoms are unstable and the radiation goes on at the expense of the internal energy of the atom. The question arises, why should these atoms be so unstable? Is it an electrical phenomenon?

And we are, of course, brought again to the problem of the electro-magnetic wave. Experiments of the past year seem to indicate that the X-rays themselves may be reflected, refracted and partially polarized, and this develops still further the idea of the similar nature of all ether waves, although there still remain several striking differences between X-rays and light rays.

The development of the electron theory of matter has largely been an outgrowth of research in radiation. We know that the velocities of the alpha, beta and gamma rays are widely different, the speed of the first being about 20,000 miles per second,

(*Continued on page* 737.)

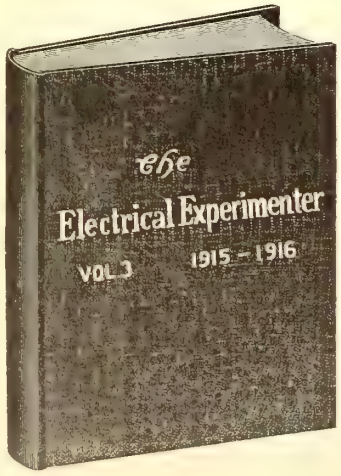


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LIGHTNING, ITS EFFECTS AND HOW TO AVOID THEM.

(*Continued from page* 683.)

thing like sharp bends around cornices and projections.

The number of conductors necessary depends on the size of the building and the comparative heights of its structural parts. There is no special area below an elevated rod which can be considered as actually protected; so that "area of protection" really cannot be defined, and no definite rule can be laid down as to the number of rods necessary to protect a building. The consideration of the extent of protection afforded must bear some relation to the value and importance of the building concerned. It should be the practise to provide at least two or more rods on any building. The best known system of protection is that referred to before.

It should be noted that any chimney stack is liable to be struck; each, therefore, should have its own elevation rod connected to the nearest conductor leading to earth. Special attention should be paid to kitchen chimneys, as a column of hot air will often be selected as a path for the flash.

The earth connection should be made either by means of a copper plate buried in damp earth, or by the tubular earth system, or by connection to the water mains. The number of connections should be in proportion to the ground area of the building, and there are few structures where less than two are necessary; if it is thought desirable to use the modified "bird-cage" system, described heretofore, each side of the building should have its own earth. Church spires, high towers, factory chimneys, etc., having two ground conductors should have two earths, which may be interconnected.

If a copper plate is used it should not be of less than 3 sq. ft. in area and not less than ¼ inch thick, rectangular in shape, with saw-tooth edges and surrounded with broken coke or graphite. If coke is used, it must be thoroughly washed to eliminate any sulphur which may destroy the copper. The conductor should be firmly attached so as to make a permanent mechanical and electrical joint.

MARVELS OF MODERN PHYSICS.

(*Continued from page* 736.)

the second 100,000 miles per second, and the third 186,000 miles per second.

This is a step toward the solution of the riddle of modern physics, which resolves itself into the question as to what is the finite nature of positive and negative particles and electro-magnetic waves.

[This is the third paper of a series prepared especially for The Electrical Experimenter by Mr. Rusk.—EDITOR.]

A 500,000-VOLT TESTING TRANSFORMER.

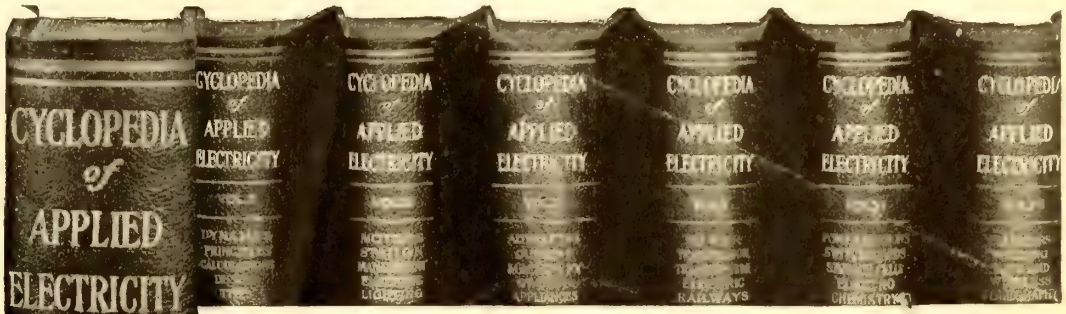
The Oerlikon (Switzerland) Works regularly manufactures testing transformers giving voltages of 200,000 and 250,000. For use in their own laboratories they have found it necessary to construct a transformer yielding in normal operation a difference of potential of 500,000 volts. The exterior shape of the apparatus is cylindrical, 3.3 meters in diameter and 3.6 meters high. Its total weight is 34 tons. It is capable of taking a current of 1,000 amperes at 500 volts. At 500,000 volts the sparking distance is 1.32 meters, and at its maximum overload, giving a voltage of 700,000, the sparking distance is 1.85 meters.

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Only strictly modern and up-to-date apparatus are described in this book, and if we asked you 50c for it, we are sure that you would think it a bargain. This book has been written by twenty radio experts who know how to make wireless sending apparatus and for that reason you profit by their experience as well as by their experiments.

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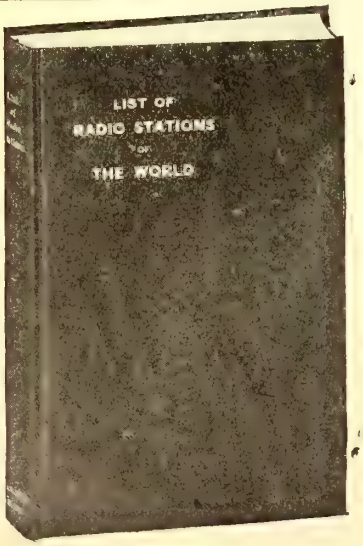
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ELECTRICITY KILLS PROMINENT WIRELESS MAN.

On Feb. 4 last Virgil J. Simpson, one of the foremost wireless men of St. Louis, Mo., met his death in the radio laboratory of the Christian Brothers College of that city.

Mr. Simpson had gone to the laboratory to conduct a radio test on a new 5-kilowatt transformer of his own design and which he had just completed. He proceeded to check up the calculations by connecting a step-down potential transformer to the secondary terminal of the large step-up transformer, which latter yielded 10,000 volts. The voltmeter was connected across the low potential or primary winding of the small potential transformer usually employed for such voltmeter readings. The accident happened while he was attempting to disconnect the test instrument from the larger apparatus, forgetting for a moment that he had not opened the main primary switch connected with the 10,000 volt transformer.

The 10,000 volt current, although of not very heavy amperage, passed through his body for some seconds before he managed to jerk away one of the leads. A companion rushed to his aid and reached his side just as the victim freed himself from the charged wire. They walked to the middle of the laboratory, but the shock had been too much for him and he collapsed. Physicians were immediately summoned and worked over him for about an hour with a pulmotor, but to no avail.

His death should be a caution to all electricians, and particularly to those in the radio field, never to attempt to make connections in high tension transformer circuits until the primary circuits are opened. A moment's carelessness, as in the case of Mr. Simpson, may spell death.

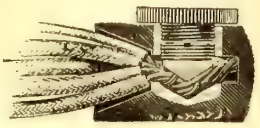
A PECULIAR ELECTRICAL ACCIDENT.

An odd electrical accident is reported in a technical paper on "Safety in Stone Quarrying," recently issued by the Bureau of Mines, Washington, D. C. A transformer supplying a stone quarry burned out, permitting 4,000 volts to pass to the hoisting motors. The man in charge placed his hand on the lever and as the machine was electrically charged he could not let go. As he was wearing rubber-soled shoes he sustained no injury. He called for help and the man who came to his assistance, instead of pulling the switch and cutting off the current, took hold of the engineer's hands and tried to pull them free and in so doing completed the circuit and was killed. The man with the rubber-soled shoes was unharmed except for slight burns.

Seventy per cent. of the people use electricity in some form every day. Most of us use it in some form during the month.

A NEW INSULATED CONNECTOR.

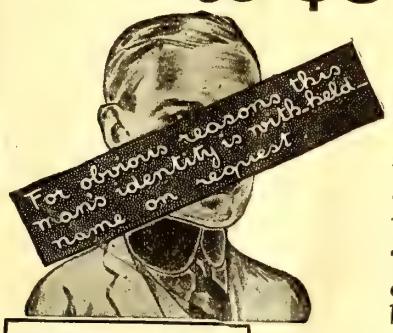
In the past the most troublesome thing about wiring has been the soldering of joints. It was very crude; in fact, soldering is one of the oldest known methods of making electrical joints and has not been improved on in any way except in the appliances used.



The new connector here pictured fills a long felt want and the connecting of wires is easily and quickly done. As will be seen from the illustration, it consists of a shell with this new instrument of hard rubber on which is mounted a thumb screw with a conical point, which fits into a cone-shaped head. The wires to be connected are twisted together and inserted in the hole at the left, then the screw is forced down by means of a pair of pliers or a screwdriver clamping the wires tightly. The resulting joint is perfect, both mechanically and electrically.

The advantage of this very clever connector will be appreciated when the number of accidents that it will eliminate are considered. With the old methods fire was often caused from the alcohol or gasoline used in the torch, damage was done by hot solder falling on furniture, etc., and the soldering acid splashing on various things.

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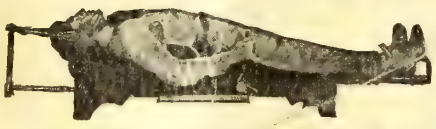
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(*Continued from page 695.*)

ber of turns, placed far from the tube so that it has no influence on the ray. If we introduce into the coil 3 iron wires, the deflection of the ray diminishes, for we have increased the impedance of the circuit.

Add to the coil 3 a condenser C, as shown in Fig. 14, for the usual technical alternating current. We observe a certain deflection. With suitable chosen dimensions of the coil 3 and the condenser it is now possible to increase the deflection by introducing iron wires into the coil 3.

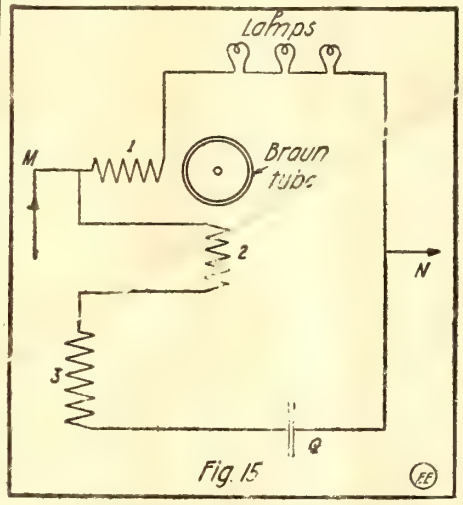


Fig. 15. Interesting Experiment with Divided Circuit and Braun-Tube.

Still another interesting experiment wherein the Braun tube plays an important part is the demonstration of a divided oscillating circuit having on one branch a reactance composed of a capacity Q and inductance L-3 in series, while the other branch contains a resistance; i. e., incandescent electric lamps P, as depicted in Fig. 15. The branch MPN is in phase with the electro-motive force; i. e., the difference of potential between M and N. The branch MQN has a phase difference; for that reason we observe on the screen of the tube an ellipse. Now let us introduce into the coil 3 an iron wire, and in so doing the shape of the ellipse is changed. As more iron is added to the coil the ellipse finally takes the shape of a straight line. If the core is removed the ellipse resumes its original form.

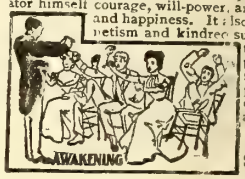
[*It is generally known that the Braun tube is the only apparatus available that will record correctly vibrations above the audibility range. In fact, frequencies up to several millions were actually recorded without any trouble whatsoever. This simple device supersedes the ordinary oscillograph for recording electrical vibrations. Moreover, the oscillograph is a thousand times more complicated and expensive; and furthermore, cannot start to do the work accomplished by the Braun cathode tube.—Editorial note.*]

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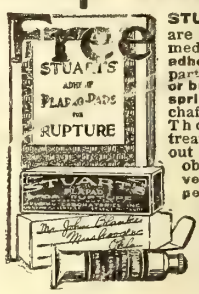
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